INDEXED

International Marine Engineering

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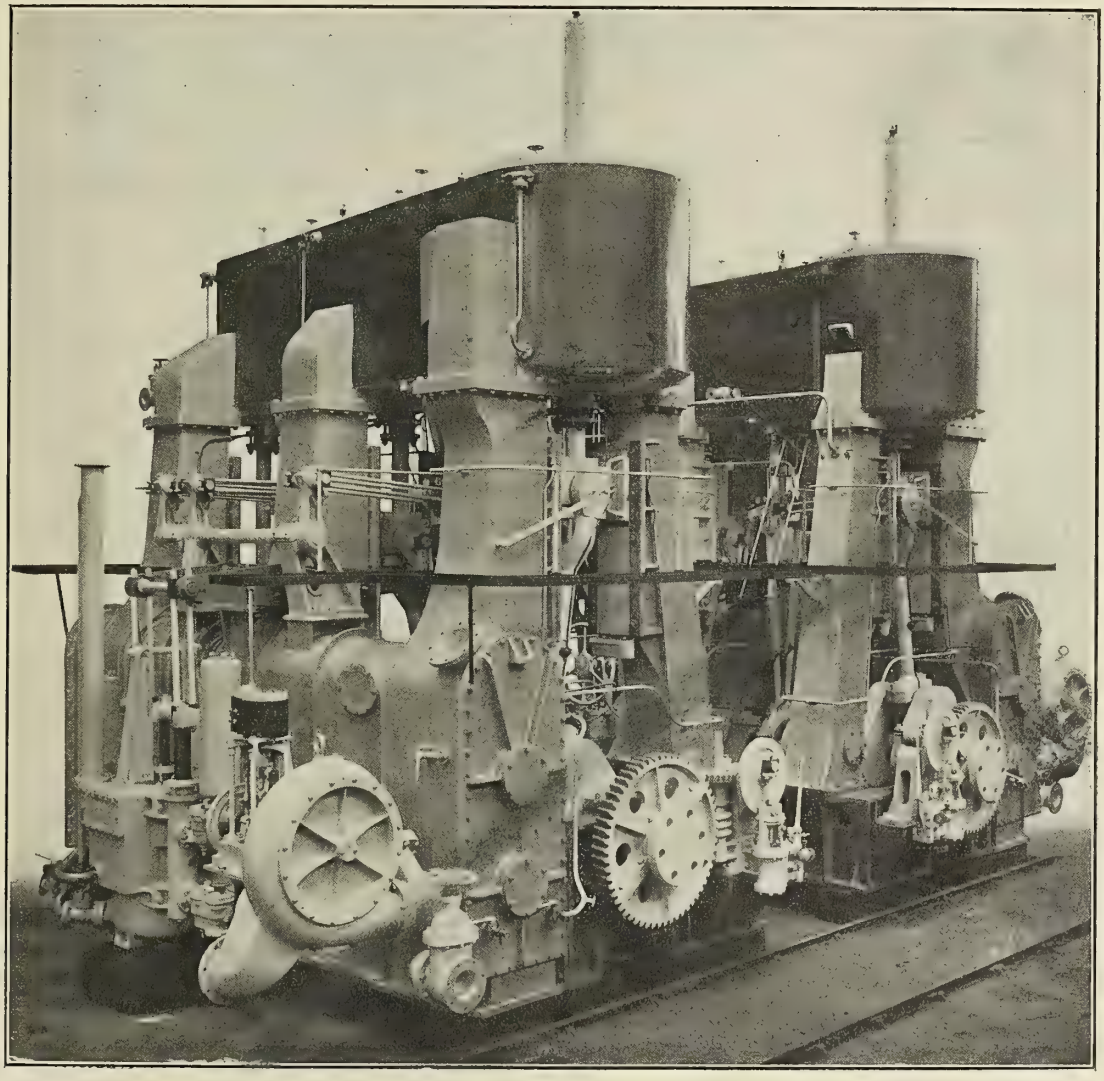
THE PORTUGUESE STEAMER LUSITANIA.

The finely modeled twin screw mail and passenger steamer *Lusitania*, built by Sir Raylton Dixon & Co., Limited, of Cleveland Dockyards, Middlesbrough-on-Tees, has recently been delivered to her owners, the Empreza Nacional de Navegacao of Lisbon, and is intended for their important mail and passenger service between Lisbon and the Portuguese possessions in Southeast Africa.



THE TWIN SCREW ENGINES OF THE PORTUGUESE MAIL STEAMER LUSITANIA.
(Photograph, Parry, South Shields.)

The vessel has been built to Lloyd's highest class and has been equipped under the Board of Trade rules for carrying passengers. Her leading dimensions are 436 by 51 feet by 28 feet 6 inches depth of hold, and she has accommodation for over 100 first class passengers, including large entrance halls, dining saloon, smoking room and music room, staterooms, etc., fitted up in a most luxurious and handsome style, with every available appliance for the comfort, safety and cuisine of the passengers. The upper parts of the walls of the saloon entrance hall, smoking room and music room are paneled in polished marble of the best description, with a heavily molded dado of polished mahogany below, and the floors covered with patent interlocking rubber tiling, excepting those of the dining saloon and lower entrance, which are of solid parquetry. There are also berths for 60 second class, with dining saloon, smoking room, etc., furnished in the most superb manner, while accommodation is also provided for over 140 third class passengers in special staterooms holding from 6 to 10 persons each.

A powerful refrigerating engine is placed in the 'tween decks

aft, and large insulated storing spaces are fitted adjacent for the carriage of fresh meats, vegetables, etc., and the comfort of the passengers during the voyage in the hot climates will be greatly improved by the introduction of a complete system of electric fan ventilation fitted throughout the ship. At the hatches there are placed six powerful steam winches and four steam cranes for the rapid handling of cargo, while in addition to the ordinary life saving appliances the vessel is provided with a large powerful steam launch.

Twin screw triple expansion engines have been built and fitted into the vessel by the North Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne, having cylinders 23½, 39, and 64 inches in diameter, by 45 inches stroke, supplied with steam by four large single-ended boilers working at a pressure of 180 pounds per square inch, and fitted with Howden's system of forced draft.

The gross tonnage is 5,560 tons, and the vessel, notwithstanding that she is equipped as a first class passenger steamer, with accommodation on board for about 420 souls in all, will carry 5,700 tons deadweight, on a draft of 25 feet, and has a capacity of about 204,000 cubic feet for cargo. Specially large bunker accommodation has been provided to enable the vessel to steam the whole distance from Lisbon to the Portuguese Southeast African possessions without re-coaling. The vessel is built on the cellular double bottom principle for water ballast, and, in addition, is fitted with deep ballast tank abaft the engine room, to hold about 300 tons of water. The double bottom itself is divided into twelve athwartship divisions, and the center longitudinal is also watertight, this being done partly for trimming purposes, and also that, in addition to the seventy tons of fresh water which is provided for in the special tanks in the 'tween decks, any additional quantity can be carried when the vessel has troops on board.

The main, spar, poop, bridge, and forecastle decks are of steel, sheathed with yellow pine, where not exposed, and all exposed decks, including boat and promenade decks, etc., of teak. The large deckhouse extends along the spar-deck for about 170 feet over the 'midship part of the vessel.

The lighting and ventilation of the public rooms is provided through a large number of square brass-framed sliding windows, and, in addition, a large and handsome dome is constructed over the smoking room, and also one over the music room, the floor of the latter being pierced by a large ornamental well, which will light the saloon below. Ample promenade space is provided for first class passengers on the bridge and boat decks. The remainder of the large 'midship deckhouse not occupied by the saloon and entrance house contains accommodation for engineers, servants, etc., at the after end; and immediately abaft the saloon entrance are the pantry and kitchen arrangements, which are large, roomy compartments, fully equipped, with all the modern furnishing for the most perfect cuisine and service.

The steering gear is by Messrs. Bow, McLachlan & Company, Limited, Thistle Works, Paisley, and consists of a set of their latest and most improved type of horizontal, combined steam and hand screw gear, of powerful scantlings, and similar to what has been fitted by them in many of the latest turbine and swift screw steamers. A feature of the gear is the application of Dobbie's patent hydraulic brake, and buffer cylinders, which take the shock of heavy seas off the steering gear, and in the event of accident enables the rudder to be locked. The gear is controlled from the bridge by patent telemotor apparatus, in connection with a pedestal aft, for steering with the ordinary control shafting independently of the telemotor. The whole of the marble work in this vessel has been supplied by Messrs. Emley & Sons, of Newcastle.

During the trials the machinery and boilers gave the greatest satisfaction, and a mean speed of over 15 knots was attained over the measured mile.

FIRST CLASS DINING SALOON OF THE TWIN SCREW STEAMER LUSITANIA.
(Photograph, Parry, South Shields.)

The tonnage of shipping entering Korean ports during 1905 is said to have been 2,000,624, of which more than two-thirds was Japanese. The United States tonnage included was 115,724, being larger than any other except Japanese and Korean. The British tonnage, which was 62,002, was below the German and Norwegian, each of which was about 110,000 tons.

American Steam Yachts.

BY G. E. SMITH.

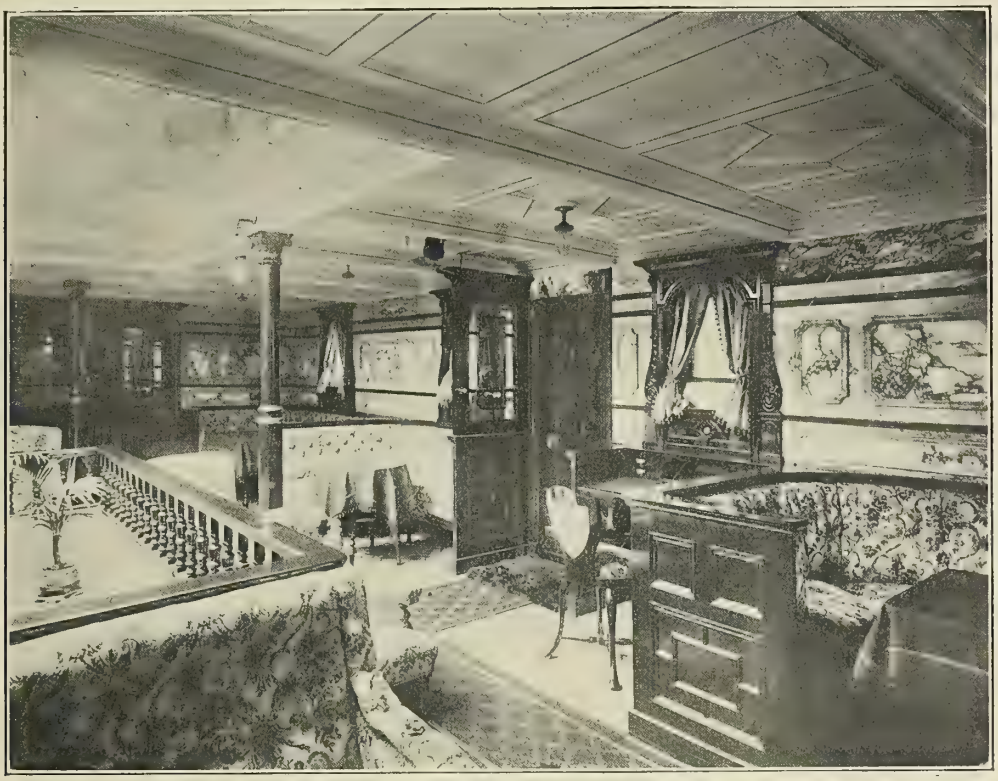
It is noteworthy that among the larger yachting craft owned by our American millionaires, many are of British design and build. There seem to have been two special conditions in the past that have brought this about, the more clear-cut "yachty" lines and homelike arrangements of the quarters on the boats of British design, and the lesser cost of construction.

Regarding the question of design, much may be said. In the first place, for sailing yachts this country holds the blue ribbon, and to a greater or less degree we have for nearly two hundred years held precedence in the design of sailing craft, both for speed and appearance. In the case of steam yachts the design has frequently been put into the hands of builders familiar with tugs and coastwise vessels, and in the endeavor to give the owner what he thinks he wants, the results have not been ideal.

One usually notices that American built yachts which have the most trim appearance and clean cut lines are from designs of naval architects. Unfortunately, however, the major part of the yachts built in this country are designed as well as constructed by the shipbuilder. The builder is rarely a yacht designer; this fact is generally apparent in yard designed yachts. The bow and stern lines are heavy, the overhangs forward and aft not well balanced, and the sheer bad. The spars are usually too heavy, poorly designed and badly located. It would hardly be tactful to criticise the bad points on any definite yachts, but there are notable exceptions among those designated by the architects; and these can be considered. In Britain, save in practical duplication, yachts are designed by yacht architects, but in this country the owners are too often willing to trust the matter entirely to the builders. Result: Incomplete satisfaction.

Naval architects in the United States have been too lenient with owners, with the same results—dissatisfaction on both sides with the finished product. The marine designer should follow the lead of the house architect, and be somewhat imperious in his requirements, for he knows better than the owner just what the finished product will be like. Of course, the owner should outline his general scheme, but the modifications, to give the best results, should be made by the architect. A roomy deck, a graceful profile, a trim rig and a comfortable interior arrangement will go a long way toward pleasing the owner, even if the scheme is not just as he planned it.

There are two general classes of yachts, those under 130 feet, used largely as house-boats, or, as in New York harbor especially, as ferries between the owner's home and place of business, and the larger or cruising type with which this paper more especially deals. In this latter class we may say the British type has been the model of the present American—in fact our modern type dates from the advent, in this country, of the former. The earlier American boats were satisfactory for plying about the harbors and rivers, but have not been fully seaworthy in the English sense. They are of shallow draft and have little freeboard. They go outside, but not unless the glass is high, Old Sol shines bright and zephyrs only are blowing. In the newer type, the effort has been to be able to go anywhere, in any weather, and this has resulted in a greater freeboard, but the style has been lacking.



SOCIAL HALL AND MUSIC ROOM ON THE PORTUGUESE STEAMER LUSITANIA.
(Photograph, Parry, South Shields.)

The foreign yachts have the style, but there are a few things in which they have usually been lacking. The speed has been unsatisfactory, and plumbing, heating and other arrangements have not been ideal. The American requires the greater speed, and he also wants the commodious and comfortable quarters of the Englishman. A roomy deck as well as good quarters below can usually be obtained with a clipper type of bow with proper overhang at the stern. This type of bow was designed originally for the heavy overhanging bowsprit and the large spread of head sails of the old time clipper ship, and the long stern was designed to handle the boom of the cutter. Simply in a matter of speed, the torpedo, or even whaleboat type doubtless gives better results. A number of boats have been built with the straight cutter bow, but the clipper is a favorite with the owners, and if properly designed it gives a racier appearance, and a dryer, easier running boat in a seaway.

The *Corsair* is a handsome, well proportioned American designed and built yacht. The *Noma* also is a credit to American designers. The *Mayflower,* now in the United States navy,

designed and built in England, is a model for a large number of modern yachts, and there is no question but that she is well fitted as a model. The American yachts have usually had good speed, due to plenty of power and good underwater lines; the trouble has generally been in the freeboard.

Where the original design has been good, satisfactory results have often been prevented by American builders insisting on using old patterns of a larger, heavier engine than is required, which means additional weight, with no better results. The machinery on a yacht should be fairly light and of the high speed type, with water tube boilers and most carefully designed pipe plan. The piping arrangement should have all the connections that are necessary, with parts easy of access, yet pipes and fittings must be compactly located and passages clear.

Naturally, the owner likes to show his friends the machinery. To this some engineers may object, but on the whole, if everything is shipshape, he enjoys showing off the good points as much as the owner. That everything may look trim and speedy the brass and finished parts should be well polished, and the passageways and ladders should be arranged to best advantage for access. Bright brass work and clean paint all add to the attractiveness of the engine room.

It is the duty of the naval architect and engineer to give his client a boat of whose appearance he may be proud. He must try to judge as to what will eventually please, rather than follow too closely the owners preliminary plans. As in all lines, the client should depend on the expert for results, and the architect should endeavor to impress this on the owner.

Where a boat is to be used for cruising, especially in Southern seas, a composite type is to be recommended. When a steel ship lies a short time in Southern waters, the bottom soon becomes foul, and the result is increased resistance, a loss of speed and therefore an unnecessary strain on the coal pile. For some reason the composite-built yacht has not been as popular as it deserves to be. The scantlings in this type are as light as for a steel ship, thus saving the weight of the heavy wooden framing, and the copper bottom keeps off the marine growth.

In suggesting changes from the owner's plan, the writer does not advocate any high handed methods, but the diplomatic handling of the clients in a way that will impress them with the fact that the designer knows whereof he speaks. Following these methods should give better results in the design of cruising steam yachts.

Launch of the Hindoo.

The steamship *Hindoo* was launched from the yard of Earle's Shipbuilding and Engineering Company, Limited, Hull, during November, 1905. She was built to the order of Thomas Wilson Sons & Company, Limited, Hull, for their Bombay trade.

The principal dimensions are: length 398 feet; molded breadth, 50 feet; depth 32 feet, molded. The vessel has been built of steel to British Corporation highest class and to Board of Trade requirements, and is fitted for carrying a large quantity of water ballast in the cellular double bottom, and also in forward and after peak tanks. She carries about 7,900 tons deadweight, and has a large capacity for cargo.

She has a poop, bridge, and topgallant forecastle, two pole masts of steel, and six steel derrick posts, each fitted with derricks and all necessary cargo gear; also powerful derricks for heavy loads. In the main hold of the vessel the system of strong pillars and girders has been adopted, which will allow practically a clear hold for stowage of cargo. There are ten powerful steam winches of Lynn & Company's special make, steam windlass by Clarke, Chapman & Company, and steam and hand steering gear by Amos & Smith, the latter fitted in the wheel house aft.

THE WILSON LINER HINDOO, COMPLETING FOR SEA AT HULL.

A deckhouse has been provided at the forward end of the bridge for the accomodation of the captain and officers. The engineers and firemen are berthed in side houses abreast the engine casing, and the petty officers and seamen are berthed in the forecastle.

The machinery consists of a set of quadruple expansion engines, and two large single ended boilers working at a pressure of 215 pounds per square inch. Economy in coal consumption and in upkeep of engines and boilers has been carefully considered in the design of the machinery. All working parts and bearing surfaces are exceptionally large, being of such proportions as will insure the engine's running at high power over extended periods without the necessity of adjustment. A superheater is fitted in connection with the boilers, the latter being fed by an installation of mechanical stokers.

The *Hindoo* has already made several trips to Bombay.

James Fisher.

The Towing Resistance of a Floating Dock.*

BY HENRY A. B. COLE, M. INST. C. E.

The author of this paper became interested some time ago in the towing of a large floating dock, and thought that an attempt might be made to deduce approximately the towing resistance of the dock from the indicated horsepower of the towing steamer, thus avoiding the expense and complication of a dynamometer. His investigations are based on two assumptions not strictly accurate, but probably fairly correct within the limits of ordinary working.

The dock is 320 feet long by 86 feet wide, and the draft at the time of the experiment was 4 feet 6 inches. The wetted surface at this draft is 31,655 square feet. The dock consists of three rectangular box-like pontoons, the center pontoon being 320 feet long by 65 feet wide, and the two side pontoons 272 feet long by 8 feet 6 inches wide. The draft of the side pontoons is 2 feet, being 2 feet 6 inches less than that of the center pontoon. Each of the two side pontoons is separated from the center pontoon by a passage 2 feet wide and open to the sea. The flow of water through these narrow lanes is considerably baffled by the brackets connecting the three pontoons together, and no doubt this obstruction to the free passage of the water along these two lanes accounts for a large portion of the resistance to towing. The dock was towed by a cargo steamer of about 9,500 tons displacement and 2,500 indicated horsepower, having a maximum speed of about 11¼ knots. In the following investigation this steamer will be called the tug.

The investigation is based upon two assumptions, viz.: (1) that the indicated horsepower of the tug is 2.25 times her effective horsepower, or, in other words, that the tug's own propulsive coefficient is $\frac{1}{2.25} = 0.44$; and (2) that the augment of the tug's own resistance due to her propeller is 40 percent of her total resistance.

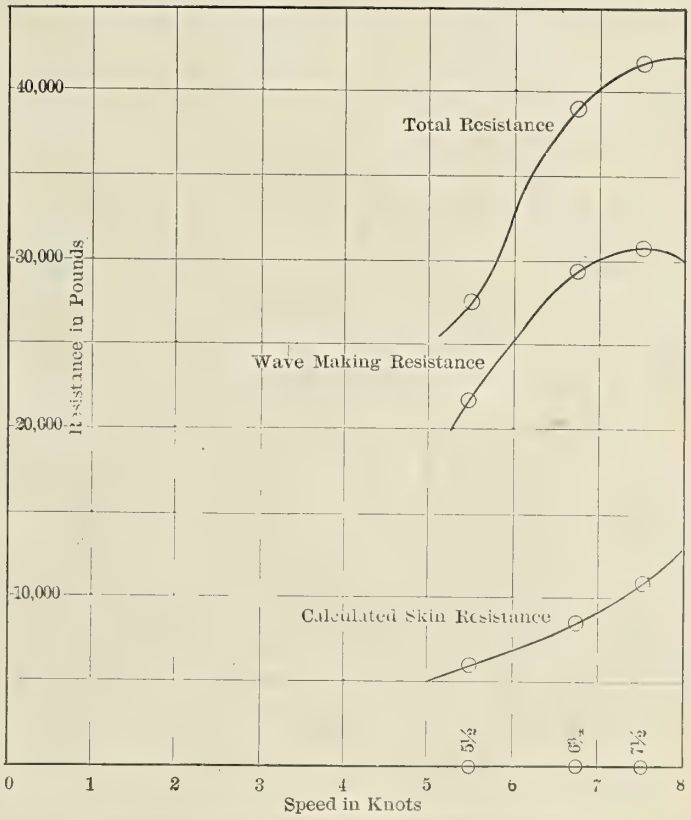
The power and speed curve for a sister ship to the tug having been previously obtained, the pull on the tow rope, *i. e.*, the resistance of the pontoon, is arrived at by the following reasoning from the foregoing assumptions. The indicated horsepower of the tug is 2.25 times her effective horsepower, but the indicated horsepower of the pontoon, having no augment due to a propeller, will be about 2.25 — 0.4 = 1.85 times the effective horsepower. For example, when towing at 5½ knots, the observed indicated horsepower was 1,094, the indicated horsepower of the tug for this speed, previously ascertained, being 240. The indicated horsepower due to the tow is the difference between these two powers, or 854. The effective horsepower of the pontoon is $\frac{854}{1.85} = 462$, and the pull on the tow rope for a speed of 5½ knots is $\frac{462 \times 33{,}000}{5.5 \times 101.3 \times 2{,}240} = 12.37$ tons. The power required to drag the tow rope through the water is considered negligible. The powers were taken for three speeds, viz., 5½, 6¾ and 7½ knots, the speeds being measured by a speed indicator, which had been ascertained to be correct within about 5 percent. It is obviously very inconvenient to try such an unwieldly vessel on a measured mile. The weather during the trials was moderate. The results obtained are given in the table:

Speed in knots	5.5	6.75	7.5
Observed indicated horsepower	1,094	1,857	2,300
I. H. P. of tug alone	240	400	570
I. H. P. of tow, by difference	854	1,457	1,730
Effective horsepower of tow	462	790	935
Resistance of tow in tons	12.37	17.24	18.36
Resistance of tow in pounds per square foot of wetted surface	0.875	1.219	1.299
Calculated skin resistance of tow, pounds	5,838	8,794	10,857
Wave-making resistance of tow, pounds	21,870	29,823	30,269

*Paper read before the Institution of Civil Engineers.

It is thought to be of some interest to analyze the total resistance of a body of such unfavorable shape, in order to ascertain in what manner the skin resistance and wave-making resistance, taken separately, vary with the speed. The skin resistance is assumed to be 1 pound per square foot of clean wetted surface at a speed of 12.8 knots, and that it varies as the 1.8 power of the speed (here taken as the square, for simplicity). The wave-making resistance is then arrived at by subtracting the calculated skin resistance from the total resistance. These resistances have been plotted in the form of curves in the figure.

A floating dock is, of course, not built with a view to economical propulsion, and it is not surprising that even at these low speeds the wave-making resistance far exceeds the calculated skin resistance. It is interesting to observe the very low speed,



CURVES SHOWING TOWING RESISTANCE OF FLOATING DOCK.

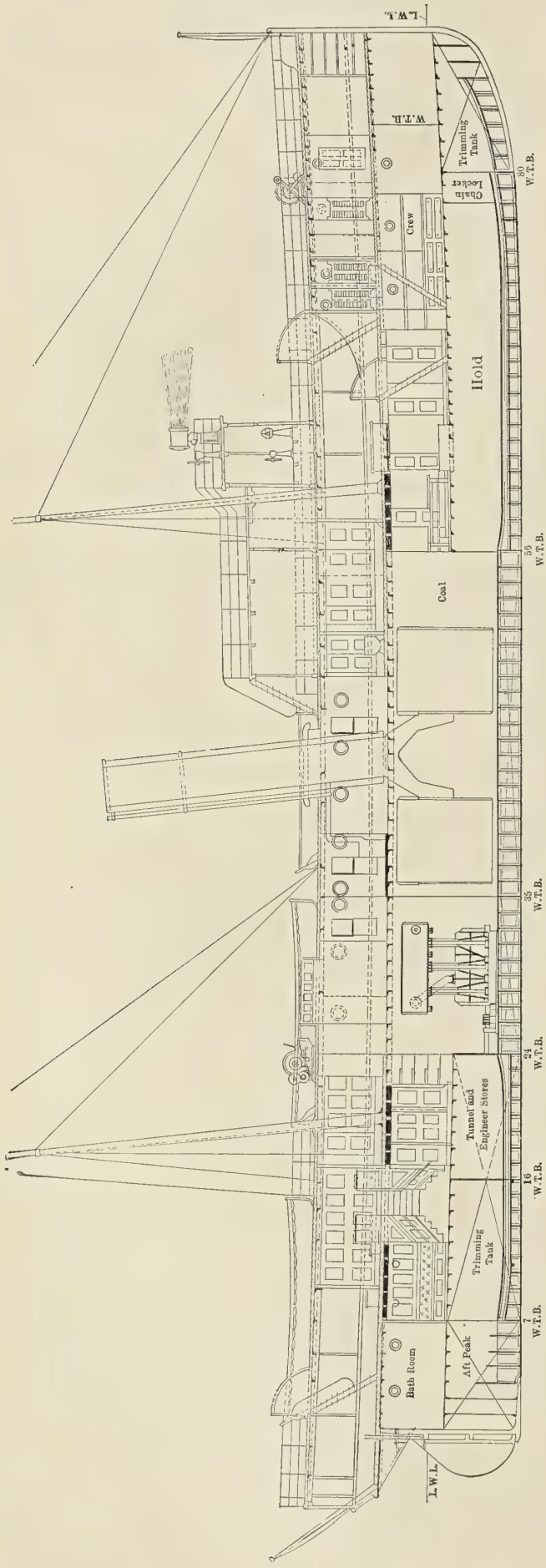
about 6¼ knots, at which the rate of increase of the total resistance begins to fall, as compared with that of properly formed ships. The average speed over the whole voyage of 6,000 miles was about 5 knots.

In estimating the power required of the tug it will be sufficiently accurate to take the towing resistance, *i.e.*, the pull on the tow rope, for similar docks, as 1 pound per square foot of wetted surface, at a speed of 6 knots, which is quite fast enough for a structure not built for progression. The effective horsepower of the tow is obtained by multiplying the resistance of the tow at 6 knots by 608 feet per minute, and dividing by 33,000. This, multiplied by 1.85, gives the indicated horsepower of the tow, and to this product must be added the tug's own indicated horsepower for a speed of 6 knots. Needless to say, a good margin must be allowed for head-winds, etc. For the case described,

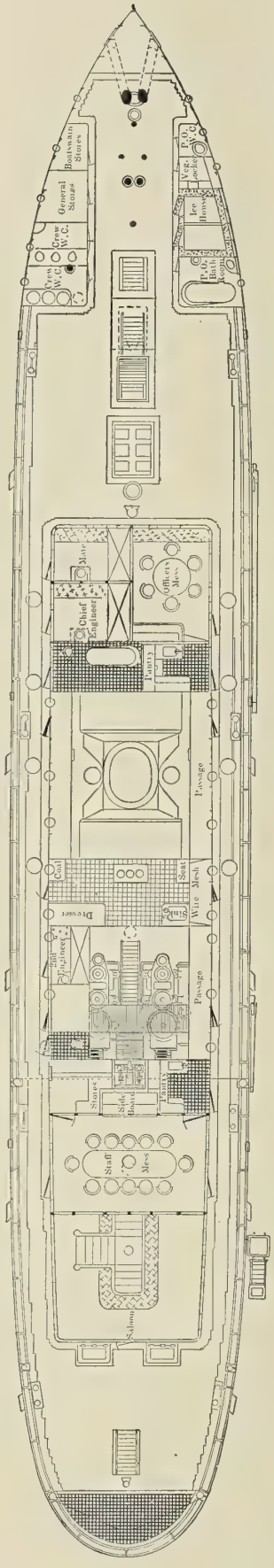
$$\text{the effective H. P. of the tow} = \frac{31{,}655 \times 608}{33{,}000} = 575,$$

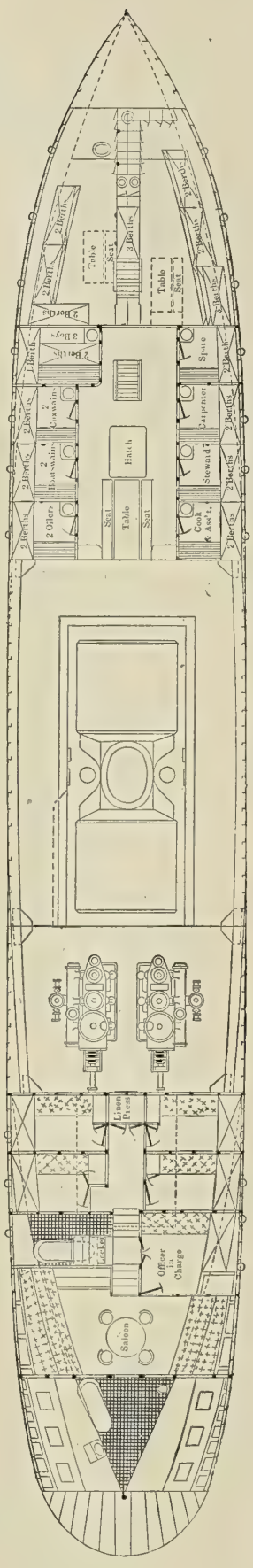
and the I. H. P. of the tow = 575 × 1.85 = 1,063.

It will be seen that the formula is very easily applied, and although no doubt not strictly accurate, it may serve as some guide to the work which a tug will be required to do when towing structures similar to that experimented upon.



INBOARD PROFILE OF THE NEW CANADIAN GOVERNMENT HYDROGRAPHIC SURVEY TWIN-SCREW STEAMER ALEXANDRA.

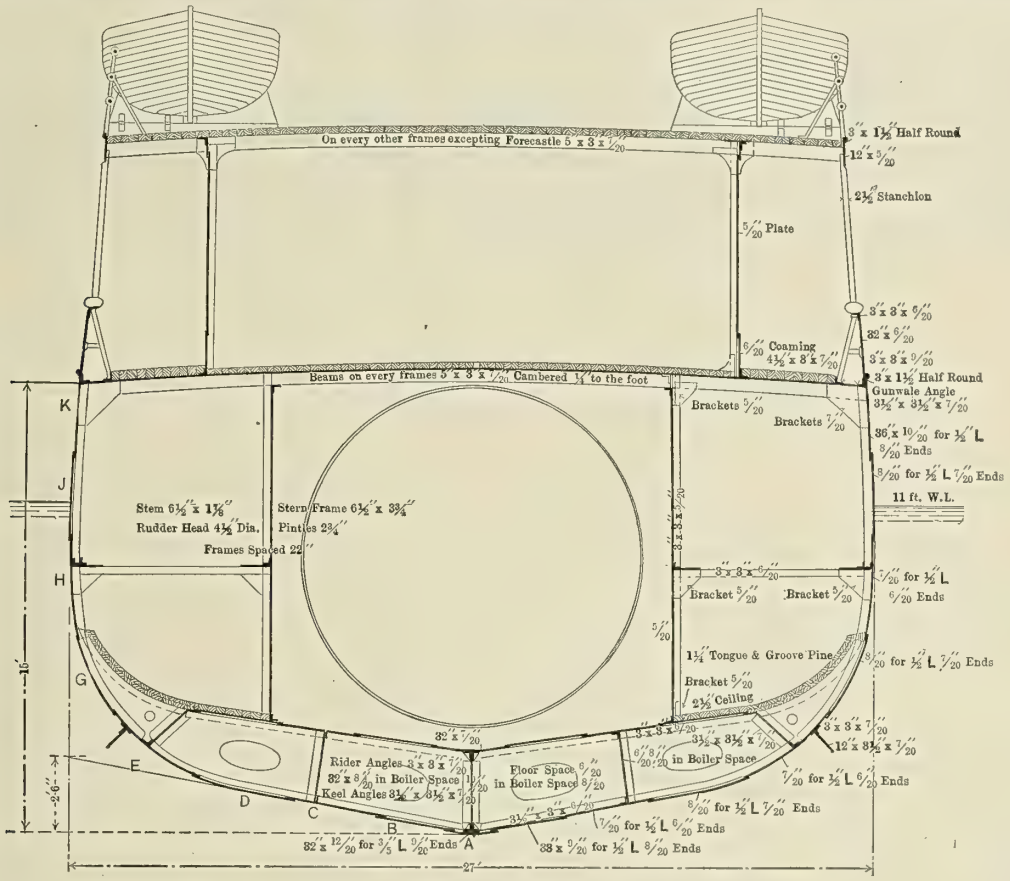




DECK PLANS OF THE ALEXANDRA. THE UPPER VIEW IS THE BERTH DECK, THE LOWER VIEW IS THE LOWER DECK.

The Hydrographic Survey Steamer Alexandra.

Contract has recently been awarded to the British Columbia Marine Railway Company, Esquimalt, B. C., for the construction of a steamer for the Canadian Hydrographic Survey, on the Pacific coast, the contract calling for completion of the vessel July 1, 1907. The plans are for a twin-screw schooner-rigged steamer, as shown in illustrations, measuring 172 feet over all, 163 feet between perpendiculars, 27 feet in width, 15 feet deep and drawing 11 feet 3 inches of water. On this draft she will carry 150 tons of coal, and will have a displacement of 780 tons. The vessel will be of steel throughout, with double bottom in machinery spaces, and seven watertight compartments, and will be fitted with bilge keels and large fresh water tanks. The scantlings are slightly heavier than required by Lloyds.



MIDSHIP SECTION OF THE ALEXANDRA, SHOWING SCANTLING DETAILS.

There will be two decks, known respectively as main and spar. The main deck forward will be sheltered from head seas by extending the bulwarks right up to the spar deck for a distance of 35 feet. Under this shelter will be bath and wash rooms for the crew, refrigerator, etc. On this deck will be a steel house 90 feet long and 18 feet 6 inches wide, thus leaving on each side a passage 4 feet wide. In the house are situated saloon and smoking room, with pantry and store room aft for the surveying staff, a large engine room, bath room, galley, cabins for engineers and mate, and bath, pantry and saloon for the ship's officers. In a small house on the spar deck will be the wheel house, cabin for sailing master and the chart room. Abaft the funnel will be fitted six pairs of Welin patent davits for two launches, two gigs and two dories, with a steam winch for hoisting purposes. The spar deck will be the full size of the main deck below it. Over the wheel house is the bridge, extending from side to side.

The main accommodation will be fitted below the main deck. The crew and firemen will be located in separate quarters forward, with petty officers in cabins between the forecastle and the coal bunker. The accommodation for the surveying staff is placed aft of the engine room, and includes four large cabins and bath room for assistants, and a cabin, sitting room and bath room for the officer in charge. The personnel will be four ship's officers, five surveying officers and a crew of thirty-three men. The vessel will be fitted with sounding instruments, a sounding winch of special construction, a set of compasses designed for exact work, searchlight and the usual electrical fittings in a vessel of this character. The shade deck is heavily constructed, for the purpose of carrying the power launches and sheltering the deck houses. The bow will be strengthened and the vessel fitted in every respect for rough service.

The twin-screw triple expansion engines have each three cylinders measuring 11½, 18 and 24 inches in diameter, with a stroke of 24 inches, and drive each a four-bladed propeller 8 feet in diameter at 120 revolutions per minute, developing a total of about 900 horsepower. Steam is to be furnished by two Scotch single-ended marine boilers, 10 feet 3 inches long and 11 feet 6 inches in diameter, fitted with forced draft on the Ellis & Eaves system, and each containing three corrugated furnaces. The total grate surface is 90 square feet; heating surface, 2,200 square feet; ratio 24.4 square feet of heating surface to 1 of grate. With a steam pressure of 180 pounds per square inch, a speed of 11.5 knots is expected; and at a moderate speed, the steaming radius is designed to be 4,000 nautical miles.

The New London (Conn.) Marine Iron Works have opened two rooms which have been fitted up near the entrance to the yard, as a lounging place and headquarters for masters, engineers and other officers of vessels laying up or repairing at the works. These rooms have a good outlook over the yard and harbor, and will be kept heated throughout the winter season, and all the principal nautical and engineering papers will be on file. An invitation is extended to all steamboat officers visiting New London to make use of these rooms.

CAR FERRY LINES OF AMERICAN RAILROADS.*

BY R. C. DAVISON AND BRADFORD BOARDMAN.

We have collected figures concerning 1,360 miles of car ferry lines operated by 35 companies. The car ferry equipment has nearly trebled since 1897, when there were 197 vessels in service, with an aggregate capacity of 2,069 cars. There are now 562 boats, carrying 5,615 cars. The size of the vessels has been much

THE SOUTHERN PACIFIC STEAMER SOLANO; THE LARGEST FERRY IN EXISTENCE.

increased, though the average capacity in freight cars remains about 10, freight cars now being about 20 percent longer than previously. The average speed of floats towed by steamers is seven miles per hour; steamers carrying cars average about 10 miles per hour. The average number of cars carried daily by all lines is 11,476.

With some small modifications, nearly all companies use the same methods for transferring the cars to the boats and securing them during transit. A counterweighted bridge is hinged at the shore end, and usually supported at the outer end on a pontoon. It is raised or lowered to the level of the float by pulleys, hand power being applied directly on a winch, or through a hydraulic ram. The Long Island adjusts the height of the bridge by a screw mechanism, operated by an electric motor. The Wiggins Ferry transfers the cars by wooden cradles on iron wheels and steel swing beams.

If the route of the boat is in comparatively quiet waters, it is very simple to fasten the cars to the float sufficiently firmly so that there is no danger of their breaking loose. There are three common methods, and most companies use at least two of them. They are: setting up the brakes on each car, chocking the wheels, and making the car fast by chains fastened to eyebolts in the deck of the float and passed around either the axle, truck, bolster or the knuckle of the coupler. At the Lehigh Valley terminals, as a rule, only the hand-brakes are set up; if the cars happen to be all connected as they come in from the road, so that the air-brakes may be set, this is done from the switching locomotive after the cars are on the float; that is to say, the air-brakes are set only when it is convenient to do so. It is not considered sufficiently necessary to take any trouble about it. The chocks are sometimes made more effective by using "chock beds," *i.e.*, timbers parallel to the track, bolted to the deck on each side of the rails, and having squared notches in them to receive the beams of soft wood used as chocks. Instead of ordinary chocks, the Grand Trunk uses rail clamps which stand 12 inches above the rail in front of the wheels, while the Northern Pacific fastens eccentric iron blocks to the rails. The Père Marquette places jacks at an angle under the ends of the body of the car, set so as to take the weight slightly off the bearings.

On the Mississippi and other rivers in the middle west, where boats are often operated in shallow water, side paddle steamers are used to carry cars; or when floats are used, they are towed by stern paddle wheel tugs. Such boats can be made with lighter draft than those using screw propellers. They also handle better when there is thin ice on the river.

CAR FLOAT NO. 10 OF THE ERIE RAILROAD, IN CHARGE OF THE ERIE TUG WAVERLY.

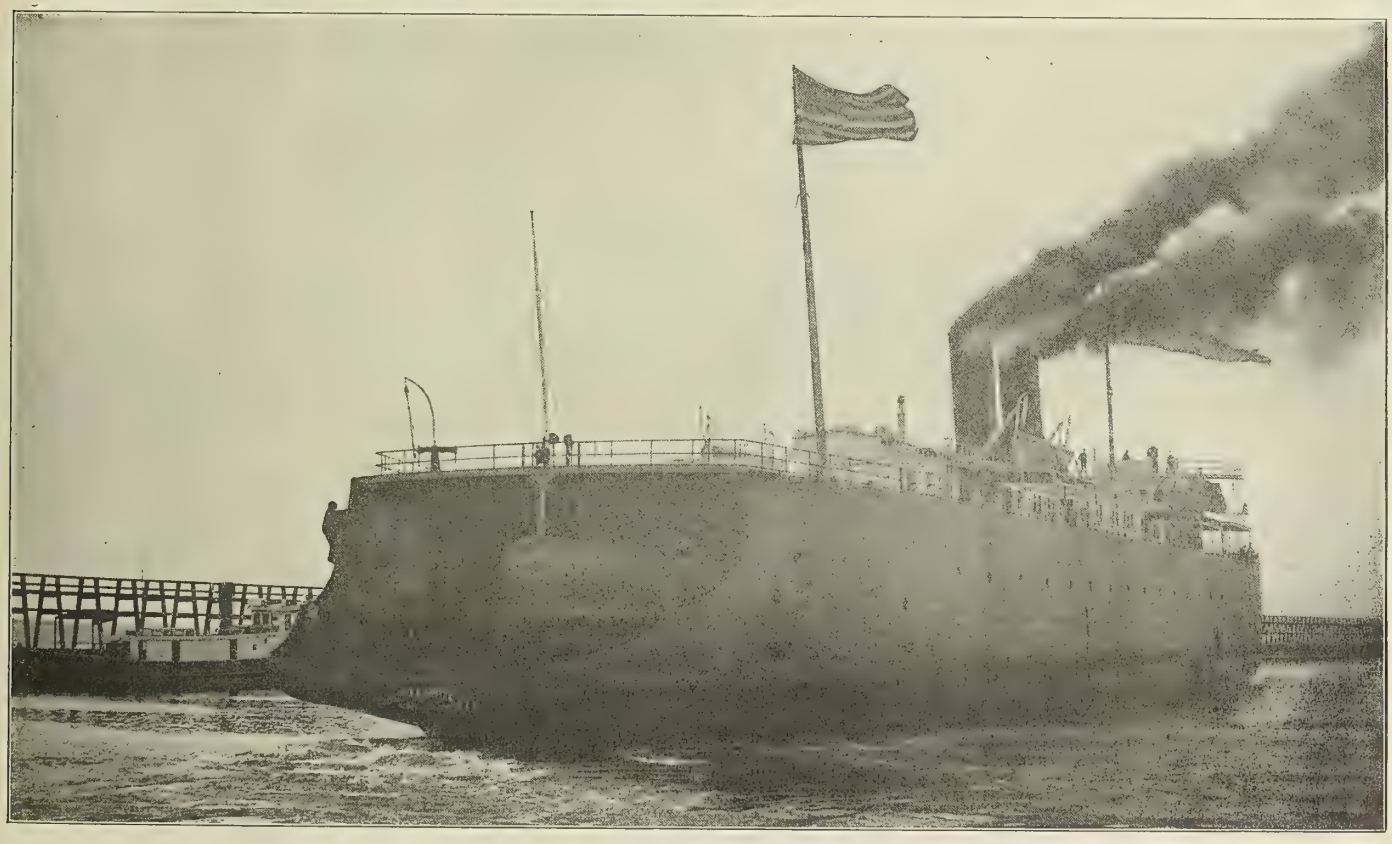
Companies which operate ferry lines in tidewater harbors use two kinds of car floats. For through car service the floats have three or four tracks, usually three, which take up the entire

*By courtesy of *The Railroad Gazette*.

QUARTER BOW VIEW OF THE FLINT AND PERE MARQUETTE RAILROAD STEAMER PERE MARQUETTE 17.

available deck room; but for pier service, that is, when the cars are run from the railroad terminal to alongside an ocean steamer, a platform is put in the middle between the tracks for convenience in unloading the cars.

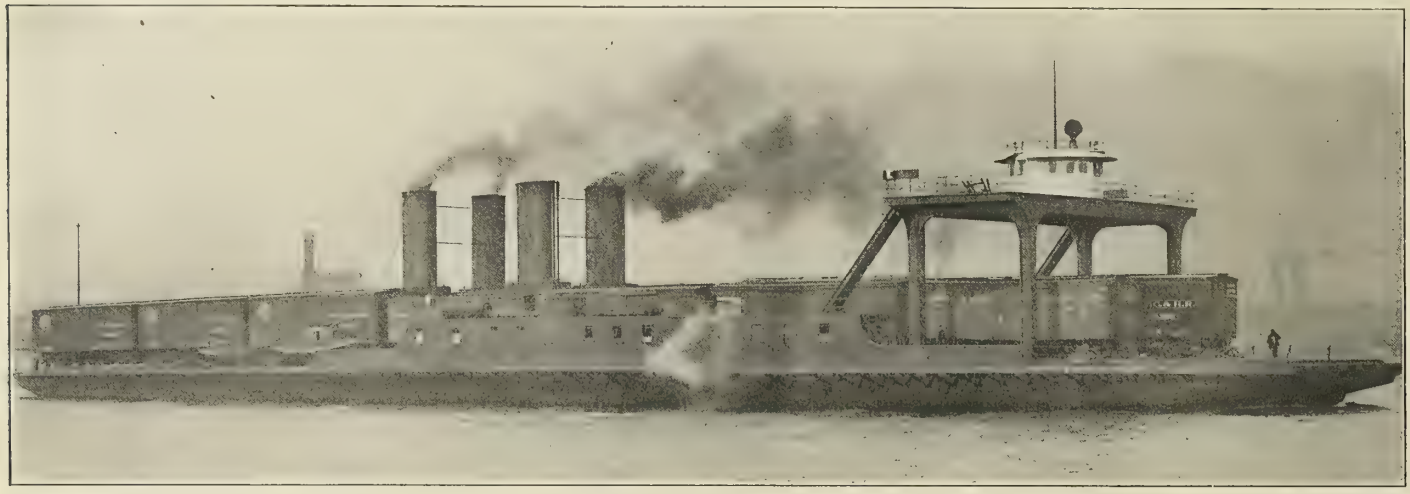
The Southern Pacific has six steamers varying in length from 265 to 420 feet. The best known is the *Solano,* which is 420 feet long over all and 116 feet 8 inches wide. When loaded, she draws 10 feet 8 inches of water. Her gross tonnage is 3,549, and net 3,057 tons. She was built in 1879 by the Central Pacific, and is made of Oregon pine. The *Solano* carries the main line trains between Port Costa and Venicia, Cal., a little less than a mile, and the average time, including the transfer of the cars from the land to the steamer, is one hour and fifty minutes for freight trains and thirty-two minutes for passenger trains. She has two beam engines, operating the paddle wheels independently, one wheel being set about 20 feet ahead of the other. The cylinders



STERN VIEW OF THE FLINT AND PERE MARQUETTE RAILROAD STEAMER PERE MARQUETTE 17.

are 60 inches in diameter, with 11 feet stroke. The engines are rated at 2,250 horsepower. Oil fuel is used, the *Solano* being the first steamer on the Pacific coast to do so. This boat has been in service for 27 years and has been laid up for repairs for only 124 days during that time, 90 days of this having been due to the breaking of a piston rod in 1895.*

view to protection against this, the bow plate being double for 60 feet, and the hulls being built out aft to inclose the propeller shafts. Two triple expansion engines are operated independently. The cylinders are 19, 31 and 52 inches in diameter, with 36-inch stroke. The maximum indicated horsepower developed is 3,500, giving the vessel a maximum speed of 15 miles per hour, though

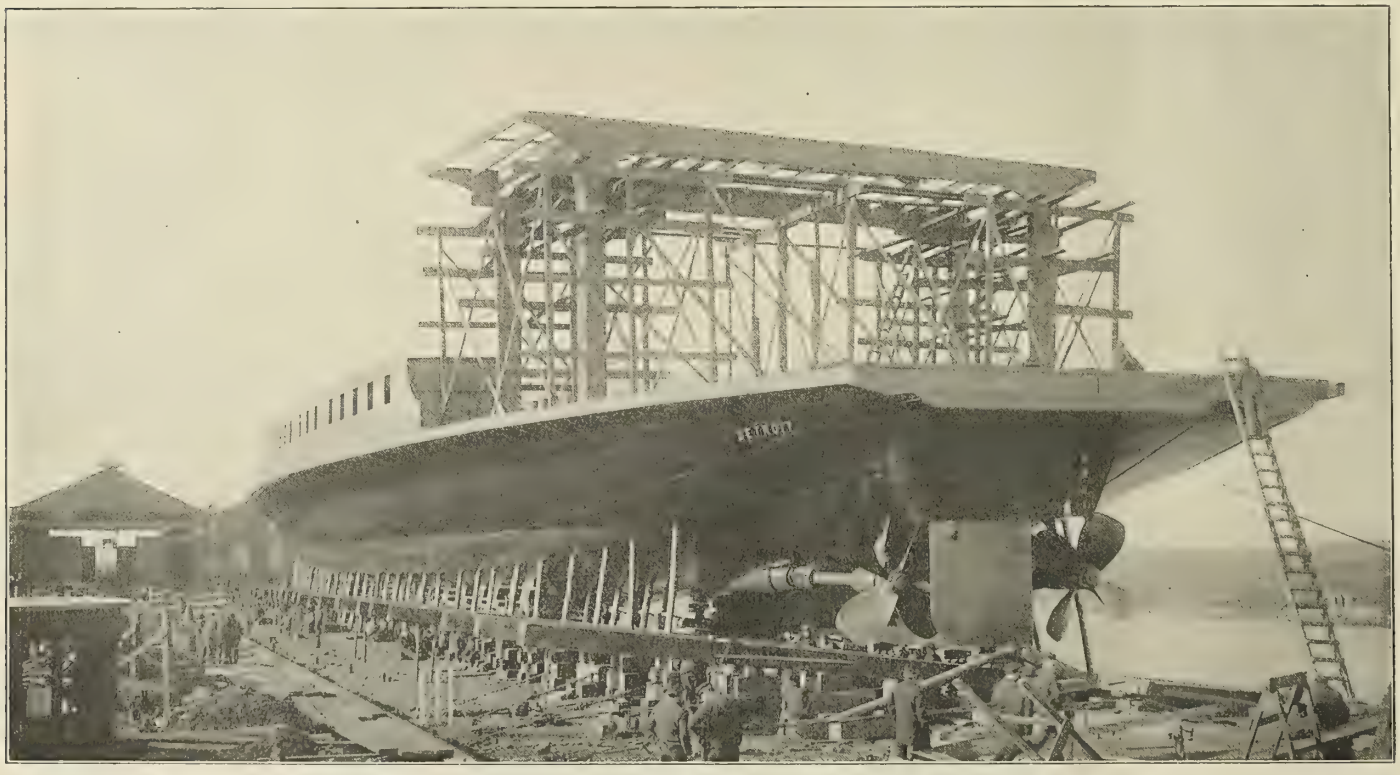


THE MICHIGAN CENTRAL STEAMER DETROIT, WITH A LOAD OF BOX CARS.

The Père Marquette steamers are particularly well known because of the great distance they travel, which necessitates an almost seagoing boat. The company has six steel steamers of 30 cars capacity, and three of less, the larger capacity boats being used on Lake Michigan. *Père Marquette 17*† is one of the latest of these; she was built in 1901, has twin screws, and is 350 feet

the average is 12½. The boats ply between Ludington and Manitowoc, 56 miles, and are in service all the year round.

The Michigan Central steamer *Detroit* was built in 1904, for use between Detroit, Mich., and Windsor, Ont., one mile. Her capacity is 21 freight cars; her net registered tonnage is 1,307, and gross tonnage 3,089 tons. The hull is of steel, 308 feet long,



BOW QUARTER OF THE MICHIGAN CENTRAL STEAMER DETROIT, TAKEN DURING CONSTRUCTION.

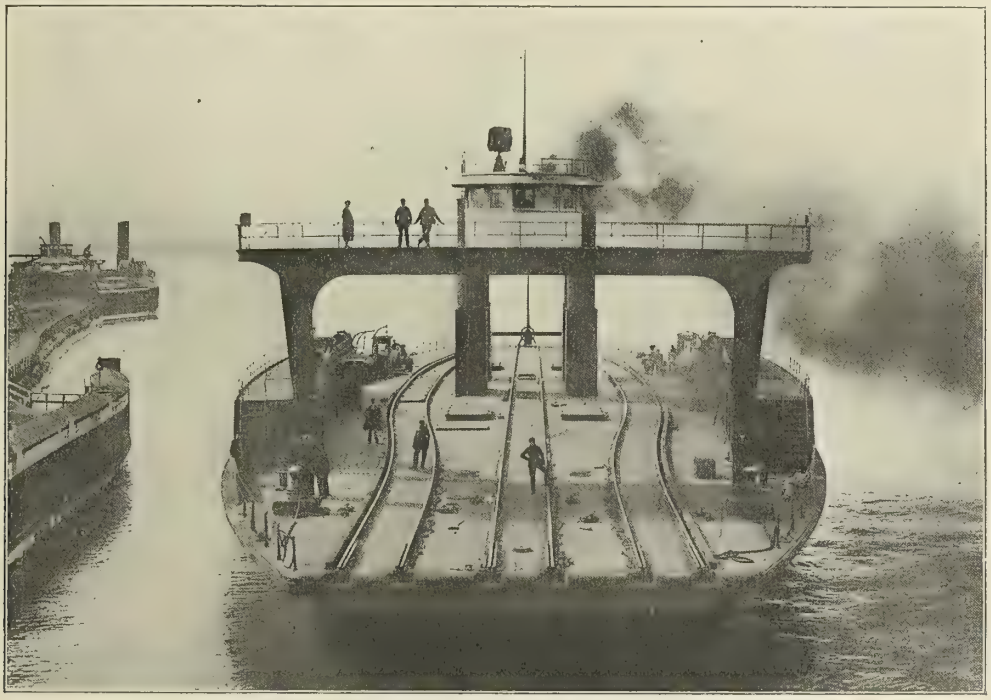
long over all, with 56 feet beam. She has four tracks on the main deck, and above the spar deck are staterooms for passengers and crew. One of the most important problems these ferries have to contend with is ice. The boats are built with a special

over all, and 77 feet wide, over all. She draws 10 feet of water when unloaded. She has four 10-foot 6-inch propellers, two in front and two behind, driven by four engines developing 3,600 horsepower. The high-pressure cylinders are 24 inches, and the low-pressure 48 inches, by 33 inches stroke. The *Transfer*, also operated over this route, is unique in having side wheels as well as one propeller.

* See page 364 of our issue for September, 1905.

†The original *Père Marquette*, prototype of *No. 17*, was illustrated and described at page 6 of our issue for May, 1897.

The California Northwestern steamer *Ukiah* is a wooden sidewheel boat 290 feet long over all and 41½ feet broad. Her gross tonnage is 2,564, and net 2,019 tons. Her draft unloaded is 6 feet. The side wheels are driven by one engine, with cylinders 65 inches in diameter and 12 feet stroke, developing 2,000 horsepower. Oil fuel is used. This boat carries 16 freight cars, and is fitted for passenger use when not transferring cars. She



END VIEW OF THE MICHIGAN CENTRAL THREE-TRACK STEAMER DETROIT.

can make the six-mile trip from Tiburon to San Francisco in less than 40 minutes, with between 2,000 and 3,000 passengers.

The New York, Philadelphia & Norfolk uses one wooden float and five steel floats; the latter are all built alike, being 340 feet long and 49 feet wide over all, with 3½ feet draft light, and 6½ feet when loaded. The hull is divided into 17 watertight compartments, each of which is reached from the deck by means of a manhole. There are four tracks on the deck; the two inside tracks carry eight cars each, and the outside ones seven each. The rails are carried on steel chairs, one pair being fastened to each deck beam. These boats were built to cross the rough waters of Chesapeake Bay daily all the year round in any weather, and excellent results have been obtained. On several occasions two compartments have been flooded in collisions, but each time the trip was completed, the cars transferred, and the barge repaired and put into service again in a short time. Automatic steam towing machines are used. The power for these, and for the steam steering gear, capstan engines, pumps, and for heating purposes is furnished from a Scotch marine boiler 5 feet 6 inches in diameter and 8 feet long. The towing machine takes up quickly any slack on the tow line, and pays it out when a heavier strain to put on it, so that in a heavy sea the pull on the towing bitts is kept constant. The machines are also useful in shortening up the towing line, and rapidly taking it inboard when the barge is about to be docked. Since it takes these barges normally about six hours to make each trip, and often longer in rough weather, sleeping quarters for the crew of six are provided amidships on a steel structure about 20 feet above the main deck.

The handling of a float at a terminal is usually as follows: The float is brought up to the transfer bridge, and made fast by ropes drawn taut by winches. There being one of these ropes at each side, this process draws the float up snug, and so that the tracks on the float and on the transfer bridge are in approximate horizontal alinement. The final adjustment is made by a ratchet working a screw by which the tracks on the bridge can be slid over a few inches. The bridge is raised or lowered before the float comes in until the tracks are in approximate vertical alinement with the tracks on the float.

If, after the float is made fast, the alinement is not accurate enough to slide the toggle bars on the bridge into the toggle caps on the float, time can be saved in adjustment by running the switch engine onto one of the bridge tracks until its weight tilts that side far enough to let one toggle bar engage the cap. The locomotive is then switched over to the other track and another toggle bar is made fast. A difference in height of several inches can be adjusted by this means in quicker time than if the float were lowered in the ordinary way. When the bridge has been used for some time, the toggle bars have a good deal of play, so that the difference in the height of the rails on the bridge and on the float may be as much as two inches. This being too much of a drop for the trucks of the tender to safely take, a flat car is coupled to the locomotive and backed up to the end of the string of cars on the float. Transfer bridges are usually double-tracked. When the float has three or more tracks, the tracks bend together, with a crossing frog a few feet from the bow of the boat. The switch points are on the bridge.

It is comparatively rare for cars to be lost from the floats while in transit; most of the accidents occur while at the dock. The engineman of the switching locomotive sometimes fails to obey the trainman's stop signal, and backs a string of cars up against the bumper. If the bumper holds, the force is usually enough to break the ropes which make the float fast, in which case the float is driven out from the dock, and the cars spilled out between the bridge and the boat. An advantage of having low bumpers, rather than high ones which reach the drawheads, is that the trucks of the last car of the string will go over a low bumper, and the car will come down on its body on the end of the boat. This makes the trouble evident at once to the engineman, who then stops the train; in such a case the fastening ropes do not break and no car is lost.

Steel floats are flat on top; while wooden floats are usually humpbacked, to give them greater strength. For this reason, in case the float breaks loose from the dock while the cars are unsecured and the brakes unset, the cars are more liable to slide

THE CALIFORNIA NORTHWESTERN'S STEAMER UKIAH IN USE AS A PASSENGER FERRY.

down grade from the middle of a wooden float than from a steel float. Another advantage of the steel float is that the bow is not so bluff as a wooden boat; it has a long overhang, and when there is ice at the pier it rides over it, instead of packing it up in front. The pontoon is weighted with rocks inside, and kept as free from water as possible, so that its lifting power may be

CAR FERRY LINES OF AMERICAN RAILROADS.

Railroad	Car Ferry Lines		Length in miles	Equipment						Capacity of largest floats or steamers	Average daily number of cars ferried	Average hours cars are on floats or steamers	Average speed, miles per hour
				Floats		Steamers		Total vessels	Total capacity, Cars				
	From	To		Number	Total capacity, Cars	Number	Total capacity, Cars						
A.T.&S.F. Coast Lines	Pt. Richmond, Cal.	Various, points, San Francisco.	7 to 9	4	56	2 tugs	—	6	56	14	133	1½	8
a A. C. L.	Pinners's Point, Va.	Portsmouth, Va. Norfolk, Va.	2 1½	4	16	1 tug	—	5	16	6	8	10	4
Baltimore & Ohio	St. George, S. I. Philadelphia Baltimore Harbor Shepards, D. C.	Various points, New York harbor Camden, N. J.; various points in Philadelphia harbor Locust Point, Canton and Colgate Creek Alexandria. Va., connecting with So. Railway	3 to 10 1½ to 3½ 1½ to 3 1	43	448	13 tugs	—	56	448	14	598	3 to 12	8 to 10
‡ Bessemer & L. E.	Conneaut, Ohio	Port Stanley, Ont.	58	—	—	1	30	1	30	30	80	5	12
California No.-West.	Tiburon, Cal.	San Francisco	6	—	—	1	14	1	14	14	—	—	16
Canadian Pacific	a Windsor, Ont. Proctor, B. C. Slocan City, B. C. Nakusp, B. C.	Detroit, Mich. Kootenay Landing ¶ Lardo Rosebery Arrowhead	1 30 63 25 36	— 6 — 2 2	— 86 — 16 16	2 3 tugs — 1 tug 1 tug	32 — — — —	2 9 — 3 3	32 86 — 16 16	16 15 — 8 8	200 120 — 32 32	½ 3 to 5 — 3½ 5	9 7 — 7 7
Central of New Jersey	Communipaw	Various points, New York harbor	Average 2 miles	23	450	7 tugs	—	30	450	22	—	—	—
a Chesapeake & Ohio	Newport News Norfolk	Norfolk Port Norfolk Port Norfolk	12 2½	3	28	1 tug	—	4	28	12	34	2½	8
C., R. I. & P.	Hopefield, Ark.	Memphis, Tenn.	1½	—	—	1	10	1	10	10	120	1/3	10

Railroad	Car Ferry Lines		Length in miles	Equipment						Capacity of largest floats or steamers	Average daily number of cars ferried	Average hours cars are on floats or steamers	Average speed, miles per hour
				Floats		Steamers							
	From	To		Number	Total capacity, Cars	Number	Total capacity, Cars	Total vessels	Total capacity, Cars				
D., L. & W.	Hoboken, N. J.	Various points, New York harbor	1 to 10	21	264	12 tugs	—	36	264	17	196	12	5
† Erie	Jersey City Weehawken	Various points, New York harbor	1 to 15	24	240	11 tugs	—	35	240	17	316	6	5
Esquimalt & Nanaimo	Vancouver, B. C.	Ladysmith	46	1	12	1 tug	—	2	12	12	24	6	—
a Grand Trunk	Windsor, Ont. Grand Haven, Mich.	Detroit, Mich. Milwaukee, Wis.	½ 84	— —	— —	3 1	44 28	3 1	44 28	16 —	540 44	½ —	6 14
a Illinois Central	Brookport, Ill. Trotter's Point, Miss.	Paducah, Ky. Helena, Ark.	3 1	—	—	2	13*b*	2	13*b*	8*c*	40	⅓ 8 min.	— —
Lehigh Valley	Jersey City Terminal	Various points, New York harbor	1 to 3½	20	254	6 tugs	—	26	254	22	225	—	6
Long Island	Long Island City	Various points, New York harbor	4 to 8½	11	166	5 tugs	—	16	166	20	250	—	7
a Maine Central	Bath, Me.	Woolwich, Me.	¾	—	—	2	16*d*	2	16*d*	12*c*	—	25 min.	—
a Michigan Central	Detroit, Mich.	Windsor, Ont.	½	—	—	4	84	4	84	21	1,090	—	6
Missouri Pacific	Ivory, Mo. *a* Bird's Point, Mo. *a* Belmont, Mo.	East Ivory, Ill. Cairo, Ill. Columbus, Ky	¾ 6 ¾	1	26	5	31	6	57	26	435	¼ ¾ ¼	5
Nash., Chatt. & St. L.	Guntersville, Ala.	Hobbs Island	20	3	24	2	—	5	24	10	18	3	8⅔
N. Y. Central	Uptown, N. Y. Term'ls	Various points, New York harbor	—	41	485	20 tugs	—	61	485	17	760	10	6 to 8
a N. Y., N. H. & Hartford	Harlem R. Term. and Oak Point	Various R. R. terminals, Jersey City and New York	6 to 13	46	771	2&19 tugs	16 P. or 31 F.	67	802	22	2,000	3	8
N. Y., Phil. & Norfolk	Cape Charles, Va.	Port Norfolk	34	6	186	6 tugs	—	12	186	30	600	—	7½
Norfolk & South	Edenton, N. C.	*a* Mackey's Ferry Columbia	9 29	— 1	— 10	1 1 tug	24 —	1 2	24 10	24 10	81 10	1½ —	10 5½
North Shore	Sausalito, Cal.	San Francisco	6	—	—	1	*17	1	17	17	—	—	7
a Northern Pacific	Kalama, Wash.	Goble, Ore.	1¼	1	18	1	20*e*	2	38*e*	20*e*	165	1/3	7
Norfolk & Western	Coal Grove, Ohio	Ashland, Ky.	½	1	6	1	—	2	6	6	40	½	5 to 10
Pennsylvania	Jersey City Camden, N. J.	Various points, New York harbor Various points, Philad'a harbor	2 to 8 2 to 10	60 20	700 180	gs gs	— —	68 23	700 180	20 10	1,000 300	2 to 24	8
Père Marquette	*a* Ludington Port Huron Detroit	Kewaunee Manistique Manitowoc Milwaukee Sarnia Windsor	57 140 56 96 1 1	—	—	9	245	9	245	30	450	—	12½
Philad'a & Reading	Port Richmond	Camden, N. J., and Philadelphia	4	28	224	4 tugs	—	32	224	8	500	1	5
a Southern Pacific	Benecia, Cal. Oakland, Cal. San Francisco	Port Costa San Francisco Visitation Point Visitation Point	1 5¼ to 11 8	1	12*c*	7 1 tug	106*f*	9	118*g*	44*h*	—	—	10
a Texas & Pacific	New Orleans	Gouldsboro, La.	1½	—	—	2	28	2	28	16	210	¼	10 to 12
a Vicksburg, S. & P.	Vicksburg, Miss.	Delta Point, La.	1	—	—	1	16*b*	1	16	16*b*	85	1/5	12 to 15
Wiggins Ferry	East St. Louis, Ill.	St. Louis, Mo.	½ to 1	3	54	2 & 2 tugs	26	7	80	30	700	1 to 2	7
Wisconsin & Michigan	Peshtigo Harbor, Wis.	South Chicago, Ill.	240	2	52	2	—	4	52	26	40	25	10

a Passenger and Freight Cars. *b* Or 10 Passenger Cars. *c* Or 6 Passenger Cars. *d* Or 8 Passenger Cars. *e* Or 11 Passenger Cars. *f* Or 58 Passenger Cars. *g* Or 64 Passenger Cars. *h* Or 24 Passenger Cars. * Narrow Gage. † Occasional Special Shipments of Passenger Cars. ‡ Operated by Marquette & Bessemer Dock & Navigation Co. ¶ Same equipment available as on Kootenay Landing line; one trip per week.

near the maximum, it being, of course, easier to let the float down than to raise it up. When the pontoon is damaged, a rope is passed under the bridge at high tide and made fast to a gallows overhead. When the tide falls, the pontoon drops with it, and can be floated out from under the bridge and the necessary repairs made. The bridges have to be made very strong. They are hinged at the shore end so rigidly as to allow no torsion at that point. When heavy cars are run on one of the tracks, their weight warps the bridge, throwing an exceedingly heavy strain on the material of which it is made.

Twelve companies have given us figures showing the average cost of ferrying one car per mile. The average is about 48 cents, the highest being $1.26 and the lowest 13 cents. This large variation is to be expected, as it is reasonable that the company which does the greatest business should do it at the lowest rates; thus the New Haven, which has 67 vessels in service and carries about 2,000 cars per day, has the lowest cost. The Long Island and the Baltimore & Ohio are the next lowest, with 19 cents. By comparing the Delaware, Lackawanna & Western and the Erie, we find that the length of time the cars are on the floats, and the ratio between the average number of cars ferried and the total capacity of the floats, seem to be important factors as affecting the cost of operation. The distances traversed by the ferries of these two roads are about the same; they have nearly the same number of vessels, whose total capacity is 240 cars in the case of the Erie and 264 in the case of the Delaware, Lackawanna & Western. But with this equipment the Erie ferries an average of 316 cars a day, while the D., L. & W. handles only 196; also, the cars remain on the floats of the last-named road for about 12 hours, as compared with six hours on the Erie, this indicating quicker handling at terminals in the case of the Erie, and consequently the cost per car per mile of the D., L. & W. is 60 cents, and on the Erie 26 cents. There are some companies which, according to the figures we can obtain, are exceptions to these general principles. Both the Northern Pacific and the Norfolk & Western ferry a large number of cars in comparison with their equipment; the cars are on the floats for only a very short time, and the floats are moved at the average speed, yet the cost per car mile is $1 on the Northern Pacific and $1.26 on the Norfolk & Western. These figures are over twice as large as those of other companies which, in equipment and amount of business, are comparable to the two roads in question.

Steel car floats have not been in general use long enough to show actual figures as to their advantages over wooden floats as regards life and cost of maintenance, but all the estimates available make it clear that their use is much more desirable. The first cost is about 25 percent greater. This will probably not be true in a few years, as the timber supply is decreasing, especially timbers of such lengths as are necessary for the construction of car floats. The steel barges are much more convenient to handle, and, in fact, there is about 25 percent saving in convenience of operation. The time saved in docking them when there is ice in the slip has already been mentioned. A most important advantage is the strength of their construction. When the floats are loaded, the first string of cars run in on a side track causes the boat to list several feet, and, since the boat is secured rigidly to the bridge by means of toggle bars or similar devices, while the shore end of the bridge is hinged so as to allow only a vertical motion, the listing of the float causes a severe warping strain on both the bridge and the float. Such a wringing tends very soon to open the seams of a wooden float; it has been found that steel floats can be built so strongly that no trouble is experienced on this account. The New York, Philadelphia & Norfolk has had steel barges in use for nine years. They are in good condition, and the superintendent estimates a life of 25 years, at least, for them. Their internal parts are more accessible than in the wooden floats.

The accompanying table gives figures concerning nearly every company in the United States and Canada operating car ferry lines. Unless otherwise noted, freight cars rather than passenger cars are understood.

COLD STORAGE ON BOARD SHIP.

PART X.

BY SYDNEY F. WALKER, M. I. E. E.

FAULTS IN AIR COOLED PLANTS.

The principal points to be looked out for in connection with air cooled plants are the condition of the air ducts, and the temperature in different parts of the hold. Dust and dirt of various kinds sometimes collect in the air ducts, and may be carried into the cold chamber, if not removed. The "freezer" engineer should examine the ducts as frequently as possible, particularly after bad weather, when everything has been strained, and when dust will have been created to a certain extent, when everything is more or less upside down; and should have all dust, and anything that can be carried into the cold chamber, removed.

The question of the distribution of temperature within the chamber is also an exceedingly important one, and the engineer should give it considerable attention. The ports in the ducts should be so arranged that air currents can be sent through every part of the chamber, and the fruit or other produce that is air cooled should be so arranged that the air penetrates to all parts. The engineer should look into this matter also after heavy weather. Bananas, crates of rabbits, fruits of all kinds, that are air cooled, should be arranged with an air space all around them. They should not rest on the floor, for instance, but should be supported on laths, or anything that will allow a current of air to pass under them, and they should not be stacked closely together, for the same reason. If they have been thrown together during heavy weather, they should be replaced as soon as it is possible to do anything within the cold chamber.

There is great danger, in air cooled chambers, of the currents of air passing across from the port of the inlet duct to the port of the outlet duct, and largely avoiding a portion of the produce. This will be especially the case if there are corners in the hold or cold chamber, in which a portion of the produce is stored, and to which it is difficult for the air to penetrate. A very liberal supply of thermometers will inform the engineer as to the temperature, and for this purpose, though the electrical thermometers described in a previous note are much better, and will give him the information he wants without his entering the hold, he can still obtain quite reliable information from a number of cheap thermometers, providing that he knows each individual instrument.

Very few thermometers, as already explained, agree. The methods of constructing thermometers vary considerably, and the ordinary method also varies in *toto* from what is supposed to be the theory of the subject, the theory unfortunately, as often happens, being wrong. But it is an easy matter to compare individual thermometers, with one thermometer that is known to be fairly accurate, and even where this is not possible, to obtain a sufficient guidance by the readings of thermometers that are not themselves at all accurate, providing that they always read the same number of degrees, for the same temperature. Thus the "freezer" engineer will be able to judge when his fruit or other produce is all right, and is keeping so, and he can mark that on a thermometer, and it will not matter whether the thermometer is really registering the correct temperature or not—the figure, whatever it may be, will be his guide to work to.

If the engineer finds that the temperature rises or falls unduly, (both are bad, as already explained) in any part of the hold or cold chamber, he must alter the current of air, either by means of the ports in the air ducts, by introducing fans, or by putting up temporary partitions, of board or sail cloth, just as mining men do, to direct air currents into particular working places. In any case he must direct more air into any corner, or any part where the temperature unduly rises, and he must divert air from any part where it unduly falls.

Another point in connection with air cooled chambers is the

direction of the air. This, it will be seen, is a most important matter, and it is not always easy to determine the direction of the air. The little apparatus called the anemometer, which is the correct apparatus for measuring the velocity of air currents, and therefore of the strength of air currents in different parts of a chamber, is very delicate, and requires a certain amount of skill in handling. Equally as good an apparatus is one of the toys that are made for children, consisting of light vanes made of paper, or any light material, held very loosely on a pin at the end of a stick. The apparatus looks like a childish one, but it is very useful for measuring the direction and the strength of air currents. It is an apparatus that any engineer can make up quickly for himself, at practically no cost beyond the time involved; and by having several of these fixed in different parts of the hold he may see at a glance, from one of the duct ports, how the air currents are going within the hold, and he can also, by constructing them of slightly varying size and form, obtain some very useful and reliable information.

Every engineer knows that in practical work, what is required is, not so much absolute measurement, as relative measurement. We do not trouble our heads about the absolute steam pressure, nor the absolute temperature. What we do trouble about is, whether the pressure or the temperature rises or falls above certain figures that we are working to. Similarly, we do not want to know the accurate velocity of the air passing through a cold chamber, but we do want to know the relative velocity passing in different parts of the chamber, and that, these little pieces of apparatus will tell us. The revolving paper vanes should be made something on the lines of the vanes of the Blackman's fan, to be effective. They should hold a certain amount of air in a sort of bag formation.

Another useful arrangement is a piece of very light dry ribbon held on the end of a stick. It is also a primitive arrangement, but one that is very easily fitted up, and very useful where the little revolving paper vanes are not available.

It is not necessary to repeat the instructions that have been given with regard to the air cooling plant itself. On board ship it can take only one form, except in very special cases, viz., a stack or grid of pipes through which the refrigerant passes, and in which it evaporates, the air to be delivered to the cold chamber being driven over the surface of the pipes by the aid of a fan. If the temperature in the hold rises unduly, or falls unduly, as a whole, not in any particular part, the air is either being cooled too much or it is being driven at too great a velocity through the cold chamber.

The engineer in this case has two methods of regulating. He can either increase or decrease the speed of the fan, increasing or decreasing the velocity of the air current, thereby lowering or raising the temperature of the air in the hold, since every cubic foot of air passing through it at a certain temperature carries off a certain quantity of heat; or he can raise or lower the quantity of the refrigerant passing into the evaporator coils, this being accomplished by opening or closing the regulator valve.

There may be the same troubles in connection with an air cooled plant as with brine cooling. The inside of the evaporator coils may receive a deposit of grease or other foreign matter, thus increasing the thermal resistance between the refrigerant and the air, and leading to the temperature of the air not being lowered as much as it should be. And again, certain portions of the evaporator coils may not be doing their work, from causes already mentioned, such as pipes having been clogged, or a leak having occurred. In such a case the temperature of the hold will rise, and it will be necessary, either to increase the quantity of refrigerant passing into the evaporator coils, or to increase the velocity of the air. The fan in this case is usually electrically driven, and there should be an arrangement enabling the speed of the fan to be regulated within certain limits, as much as from one to ten, so that probably increasing or decreasing the air current will be found a very convenient method of regulating the temperature in an air cooled hold.

Where a compressed air plant is employed, the air from the cold chamber being drawn into the compressor, compressed, cooled, expanded and redelivered to the chamber, there are two important points to be attended to. The apparatus, whatever it may be, for cooling and drying the air, directly after it leaves the compressor, should be kept in proper working order. It usually consists of some arrangement in which the air passes upwards over a number of broken surfaces, such as a number of glass marbles, this being one form used by a London firm, and meeting a current of cold water passing down over the same surfaces. The arrangement is exactly the same as that employed in cooling towers on shore. The apparatus, in this case, performs the double office of partially cooling the air which has been heated in the compression cylinder, and of removing the moisture which has been brought over from the cold chamber, the moisture being removed by the fact of cooling, and by the production of a difference between the vapor tension of the air and that of the cooling water.

If the temperature of the cooling water rises, as when the ship passes into the tropics, it is evident that the same quantity of water passing will not effect the same cooling. It is of the very highest importance that the air should be cooled down as much as possible, before it passes into the expansion chamber, where the principal cooling takes place, and also that the moisture shall all be removed from it, as far as possible, for the reason that if there is any moisture present, it will tend to freeze within the evaporating cylinder, and in the delivery ports from the evaporating cylinder, and so on. The engineer, therefore, who is in charge of a compressed air plant, will be wise to "freeze" his attention on the air drying apparatus. With compressed air, also, there is the great danger of leakage of heat into the duct leading from the evaporating cylinder to the cold chamber, and into the ducts that distribute the cold air. There is only one method of overcoming this, and that is, by maintaining the insulation intact, and there is only one method of ascertaining whether anything of the kind does take place, and that is, by observing temperatures everywhere.

FAULTS IN COLD CHAMBERS.

Faults in cold chambers, cooled by means of brine or expansion coils, are of very much the same kind as those mentioned in connection with air cooled chambers, and the ducts of compressed air. The great source of trouble with cold chambers is the lowering of the insulation of the chamber itself. It has been explained, in the early part of these articles, that there is no such thing as a perfect insulator for heat. Heat always passes through the most perfect insulating wall that has yet been devised, and at a certain rate; and the cold storage plant, the compressor, condenser, evaporator, etc., are designed to remove the heat that passes through the insulating walls, as it passes through, and to deliver it continuously to the cooling water of the condenser.

So long as the insulation remains at a certain figure, that is to say, so long as heat passes through the walls, floor and ceiling at a certain definite rate, and so long as the plant itself is working normally, the heat passing into the chamber is continually carried away, a certain number of heat units being carried off at each stroke of the compressor. If, however, the insulation fails, an increased quantity of heat passes into the chamber, and unless the evaporator or the brine coils carry off the increased quantity, the temperature will rise.

Again, the engineer will be wise to watch his temperatures by any means in his power, by the aid of electrical thermometers if possible, but in any case by the aid of any thermometers that he can obtain. If he finds the temperature of his cold store rising, he should first ascertain whether the plant is working all right. It may be taken as an axiom that in all work of this kind, where testing for faults is necessary, the engineer should commence at the very beginning. He should commence at the

compressor, see if that is in the condition described, see if the condenser and evaporator gages are recording as they ought, see if the delivery pipe is in the condition it should be. If all these things are right, and the temperature goes up, it will probably be accompanied by a fall in the pressure at the evaporator gage, since the system will be endeavoring to do more work. With brine cooling, the engineer has then two methods of dealing with the problem. He can increase the velocity of the brine circulation, by increasing the speed of the pump, or opening the valve of a particular brine pipe, or he can increase the quantity of the refrigerant passing into the evaporator coils, where the trouble is common to all. He will be guided by circumstances as to which course he takes. In some cases it may be easier and simpler to slightly increase the speed of the pump. In cases where a pump runs at a constant speed he cannot do this, and he must increase the quantity of the refrigerant.

In the case of chilled meat, where it is so important, as explained, to maintain the temperature within a few degrees of a certain figure, neither going up nor down, if the engineer finds his temperature going down, probably his best method of dealing with the question will be decreasing the velocity of the brine circulation in the particular chamber, by closing the valve partially. Where there is more than one hold or cold chamber supplied with brine coils, the matter is regulated simply by altering the valves on each branch of the system.

RECEIVING MEAT AND PRODUCE.

Meat that is to be carried frozen is usually frozen as soon as it has been killed, at the station where it has been grown, and is, or should be, carried in refrigerating cars to the ship's side. Where, however, this is not done, or where meat is received newly killed, to be placed in cold store, and where it is to be held frozen, or chilled, it should on no account be exposed to a very low temperature for some time after it has been killed. What is known as the animal heat should always be allowed to get out of the meat, by radiation, before any cooling is attempted. The time occupied in getting rid of the animal heat varies considerably. Where times presses, and where it is not of such a great importance—say where the meat will not have to be kept for a long time, as when it is intended for the use of the ship's company or passengers—the meat should be allowed to hang in the ordinary temperature as long as possible, and then it should be submitted to a gradually lowering temperature, the heat being slowly extracted from it in this way, until finally it is frozen or chilled, as required.

Meat received in this way should on no account be allowed to lie on the floor, nor to touch the walls or the ceiling. In ships which carry chilled meat, it is usual to suspend carcasses or quarters by hooks arranged for the purpose below the ceiling, and in such a manner that the air has free access to every part of the carcass. Where this cannot be done, where it is necessary to lay the meat on something, battens or gratings, or something similar, should be laid on the floor of the cold chamber, and the meat laid on them, being so arranged that the air has a clear passage under the meat, over it and all around it; and if it is necessary to lay the meat in tiers, successive tiers of battens should be provided, fulfilling the same conditions. The same remarks apply to crates of rabbits and similar produce. Rabbits are packed loosely in small open crates, giving clear passage of air through them, and these should be placed a little off the ground, and if obliged to be stacked one above the other, should be arranged by means of battens with air spaces between them. It is particularly important in the case of chilled meat, that the cooling should be performed very gradually indeed.

If the meat on the outer surface is frozen first, or even if its temperature is very much reduced before that of the inner portions, it is very liable to lead to what is known as "bone stink." In plain terms, the inner portion of the meat sets up organic chemical action, and rots. When this does not actually occur, a lesser evil may be met—the minute cells and vessels of which the muscular portions, the eating portions of meat, are composed, sometimes burst, and the juices they contain are lost, with the result that the meat so preserved, when it comes to be cooked, is found to have no gravy, and very little flavor, and is consequently sold for a very low price.

THAWING OUT.

It will usually not be within the province of the "freezer" engineer to thaw out meat, except for the use of the ship's company or passengers. When he has to perform this work, however, it cannot be too carefully done nor too gradually. The meat to be thawed should be removed from the cold chamber to one only a little higher in temperature, or arrangements should be made to slightly increase the temperature of that portion of the chamber in which the meat to be thawed out is placed. This may be accomplished by the aid of temporary screens of board or *dry* sail cloth. In any case the temperature should be gradually, very gradually raised, the object to be attained being that the higher temperature of, say, a very few degrees, shall penetrate right into the substance of the meat, before the outer surface is subject to a further increase of temperature. If this is done carefully, the meat so thawed, providing it has been carefully chilled or frozen, will turn out well when cooked. If this is not done, the flavor of the meat and its quality will be very much deteriorated.

In thawing out holds it is best to circulate hot brine in the brine coils, rather than to use fires, or similar arrangements. The brine should be gradually increased in temperature, and should be kept in circulation until the hold is thoroughly dried. The insulation will be all the better for it.

HANDLING MEAT AND PRODUCE WHEN LOADING AND DISCHARGING.

Do not *handle* the produce more than can possibly be helped. On no account place the hands on the meat or fruit that is to be stored, if it can possibly be avoided. The enormous quantity of frozen sheep which are brought to England from New Zealand are all inclosed, each sheep in its own linen bag, which avoids the necessity of hands touching the carcasses, though the results of touching a hard frozen substance are not so serious as those of touching a chilled meat surface, or the surface of fruit, etc. The linen bags also form a very convenient arrangement for identifying particular consignments, each bag being marked with the owner's, consignor's, or consignee's name.

With chilled beef and with fruit the matter is sometimes a very difficult one. Fruit should be handled in crates, so that the hands do not touch the produce at all, either loading or unloading. In the case of bananas, they can be handled, or should be, by the stalks.

One great source of trouble in connection with chilled meat is the muggy atmosphere that is so common in the United Kingdom, and is also met with in every part of the world where fogs prevail at certain times of the year. This muggy atmosphere contains moisture held in suspension in the well known manner. It is able to hold a certain quantity of moisture when at a certain temperature. If any portion of the air is cooled, a deposit of a certain portion of the moisture it contained follows, usually on the cold surface, bringing the cooling effect. When chilled meat is removed from the hold to the railway trucks, say, or to a cold store, where there is one on the dock side, there is always a great danger if the atmosphere is in that muggy condition mentioned, of the deposit of moisture upon the surface of the meat, which is nearly always at a considerably lower temperature than that of the atmosphere, with the result that the meat is seriously deteriorated, and its market value reduced. The problem of how to meet this is an exceedingly difficult one.

Probably the best method is, to ascertain by means of a hygrometer the actual humidity of the atmosphere, to note carefully its temperature, and if possible to raise the temperature of the meat to be discharged to that of the atmosphere, or a little above it. Whether moisture deposits from the atmosphere on the meat will depend upon the temperatures of the two, and upon the

vapor tensions of the moisture in the atmosphere, and that issuing from the meat. It will be better, if possible, for a little vapor to be given off from the meat, than for moisture to be deposited upon it. If the meat is carried into cold store almost directly from the ship, or at any rate very shortly after, it will be quite easy to reduce the temperature again, and to do it carefully, and the meat will be preserved.

It is not so easy to arrange this where the meat is to be discharged into refrigerating railway cars, and it is absolutely impossible where the meat is to be discharged into ordinary railway cars or carts. In the latter cases all that can be done is to wrap each individual carcass with dry substances that are good thermal insulators, so that the hands of the carriers may not touch them, and that the moisture may not be deposited directly on them. Almost any form of cloth, providing that it is thoroughly dry, will answer, and a very good thing for temporary use, if it can be obtained, failing anything else, is brown paper. It must not be forgotten, of course, that all fabrics and paper are porous, and absorb moisture, and therefore they should be removed immediately their work is done, if they have become wet. The wrappings also should be as thick as possible, so as to offer the highest resistance to the passage of heat from the atmosphere to the meat, and also to absorb as much of the moisture that may be deposited, as possible.

In the railway trucks, even if they are not fitted with cooling apparatus, providing that they are open, constructed in the same manner as crates are, and providing that they are placed in the cars in such a manner that the air can get all around them, if the trains are hauled away quickly as they are loaded, it is probable that not much harm will take place if the above precautions are taken.

THE DREDGER SANDPIPER, BUILT FOR WORK ON THE HOOGHLY RIVER, CALCUTTA, INDIA.

A New Dredger for India.

By the operations of the large and very powerful suction and discharging dredger *Sandpiper*, launched recently from the works of Wm. Simons & Co., Limited, Renfrew, the Calcutta Port Commissioners hope to remove the difficulties to navigation on the River Hooghly. This dredger, which is 235 feet in length, has been especially designed for the unique character of dredging to be done on the Hooghly, and has been constructed under the direction of the engineer in chief to the Mersey Docks & Harbor Board of Liverpool.

The propelling and pumping engines are placed in two independent compartments, each engine room being fitted with all modern auxiliaries. Propelling power is supplied from two sets of triple expansion surface condensing engines, with steam and hydraulic reversing gear, steam turning gear, independent circulating pumps, automatic feed pumps, feed heaters and filters, large evaporators for feed water make up, and a complete outfit of auxiliary feed and bilge pumps. Steam is generated by four large single-ended horizontal multitubular boilers, constructed to Lloyd's and the Manchester Steam Users' Association for a working pressure of 180 pounds per square inch. These boilers are fitted in two stokeholds, communicating with each other. Steam ash hoists are fitted in each boiler compartment. The collective indicated horsepower of the engines is 4,500.

In view of the dredger's being employed in a hot climate, special study has been devoted to the ventilation of the engine and boiler spaces. The pumping outfit, placed forward of the propelling engines in an independent engine room, consists of two sets of triple expansion engines, with independent condensing plant and circulating pumps. The pump engines are coupled direct to two centrifugal sand pumps, specially designed to raise and discharge 5,000 tons of sand per hour at the low rate of 13 percent of sand to 87 percent of water, or, in other words, the two dredging pumps together are capable of dealing with about 80,000 tons of sand and water per hour. It was found from actual experiments that the maximum quantity of sand that fast flowing rivers can carry in suspense is 13 percent, hence the reason for restricting the volume of sand to be discharged by the *Sandpiper* to this amount.

The almost universal practice in carrying out dredging operations is to dispose of the material raised in one or other of the three following ways: (1) by discharging into the dredger's own hopper; (2) by discharging into hopper barges; (3) by discharging ashore for land reclamation. But at Calcutta it is proposed to discharge the material raised by the pumps directly into the river, the fast current of which, it is confidently expected, will convey the spoil to deep water before the sand has had time to settle.

Each pump is connected to a separate suction pipe placed one on port and one on starboard side of the vessel. Each of the suction pipes is fitted at upper end with a very massive swivel bend, which serves as a trunnion or hinge upon which the pipe is free to move, either vertically or horizontally. The swivel bends are carried in slides on the ship's side, which permits of the suction pipes and swivel bends being brought completely inboard when required. Large sluice valves are fitted on the suction connections at ship's side. The suction end of each pipe is fitted with a specially designed nozzle to suit the character of the material to be dredged. A grid is fitted to the nozzles to exclude material which might choke or damage the pump. Each suction pipe is controlled by two independent derricks, one for each end, which are both worked from the same steam winch, placed on deck. These derrick winches are of most massive construction; each has four independent drums arranged to work separately or together, as required, for lowering, hoisting

and derricking the pipes inboard. These winches form one of the most important details for the successful working of a dredger of such large dimensions, and are so arranged that one man is capable of manipulating the whole of the movements. The discharge pipes from each sand pump are carried aft under deck on each side and united into one 51-inch diameter pipe under the vessel's counter.

Special flexible connections are provided to meet the varying conditions between loaded and light draft of the dredger and floating pipe line. One of the features of the deck equipment of this dredger is the extensive and powerful installation of mooring winches, to regulate her movements in the rapid currents of the Hooghly. The winches are placed at bow and stern, and consist of two duplicate sets, each having six independent drums and two ends for warping purposes; two of the drums being arranged to work chains, while four of the drums are of very large diameter for working long lengths of heavy steel wire rope. Each winch is driven by a vertical high-pressure engine, the gearing throughout being of steel.

A large workshop is fitted under deck, so that all general repairs may be effected on board. The outfit of machine tools is very complete, and consists of lathe, shaping machine, radial drill, and smith's forge, with mechanical fan, all driven by electric motors.

The hull and machinery are constructed to Lloyd's highest class. The deck is of steel, sheathed with teak. Steam and hand steering gear is fitted, and a very complete installation of electric lighting is provided, including two searchlights. Elaborate cabins are fitted up for the European officers and port officials, and provision is made for a large native crew. A refrigerating chamber is fitted up below deck for the preservation of provisions. A steam launch is provided for general service purpose, with special apparatus for lifting and laying moorings.

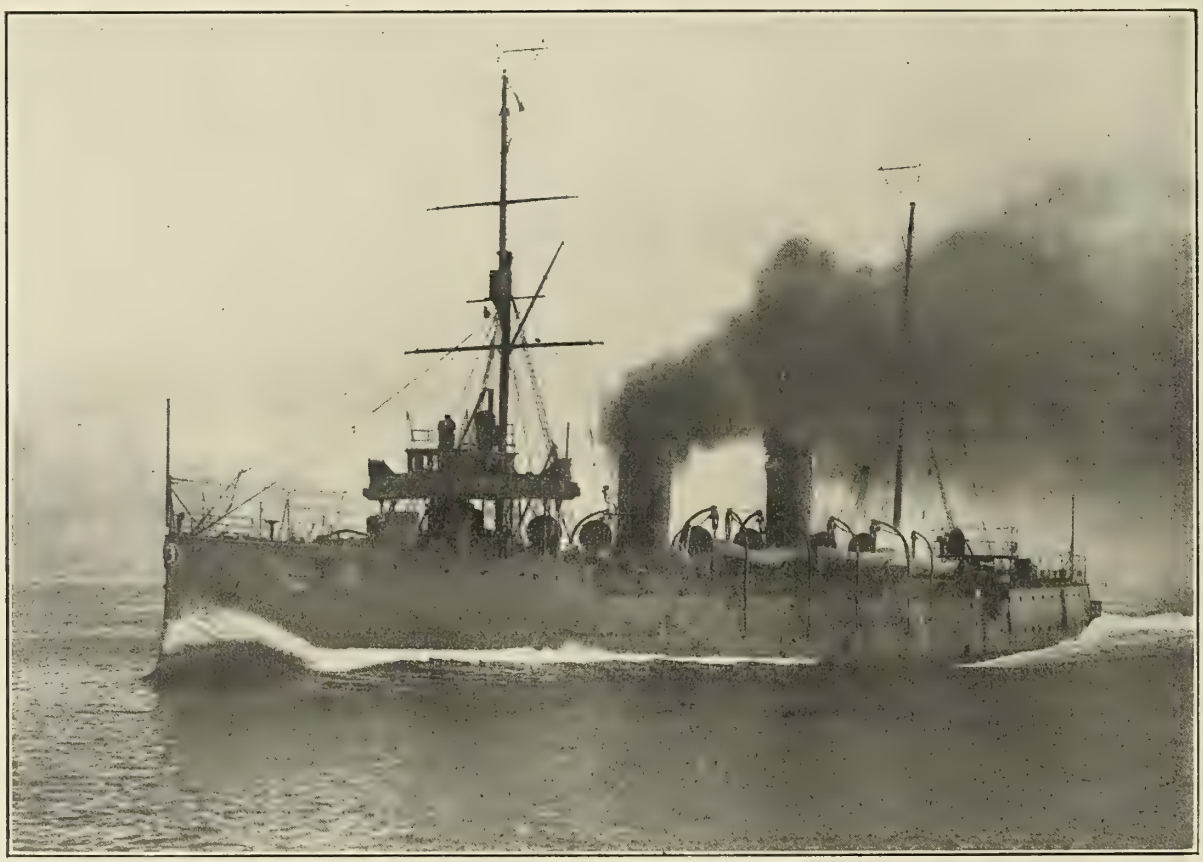
The floating pipe line in connection with the dredger consists of 600 feet of 51-inch diameter steel piping, carried on twelve pontoons. Each length of pipe is coupled to the next by cast steel universal joints, designed to give flexibility in any direction.

New Peruvian Warships.

BY BENJAMIN TAYLOR.

We present a photograph of the Peruvian cruiser *Coronel Bolognesi* as she was launched on September 24, 1906, from the yard of Vickers, Sons & Maxim, Limited, at Barrow-in-Furness.

This vessel, with her sister ship *Almirante Grau,* are the pioneers of the modern navy which the Peruvians desire, and the latter ship had just returned from her trials when the *Coronel Bolognesi* was launched. These two cruisers are somewhat similar in design to the British scout class, although their armament will not enable them to stand up against heavily armored vessels. In combination with high speed, it is to enable them to harass heavy fighting ships, and at the same time to meet attack by torpedo boats.



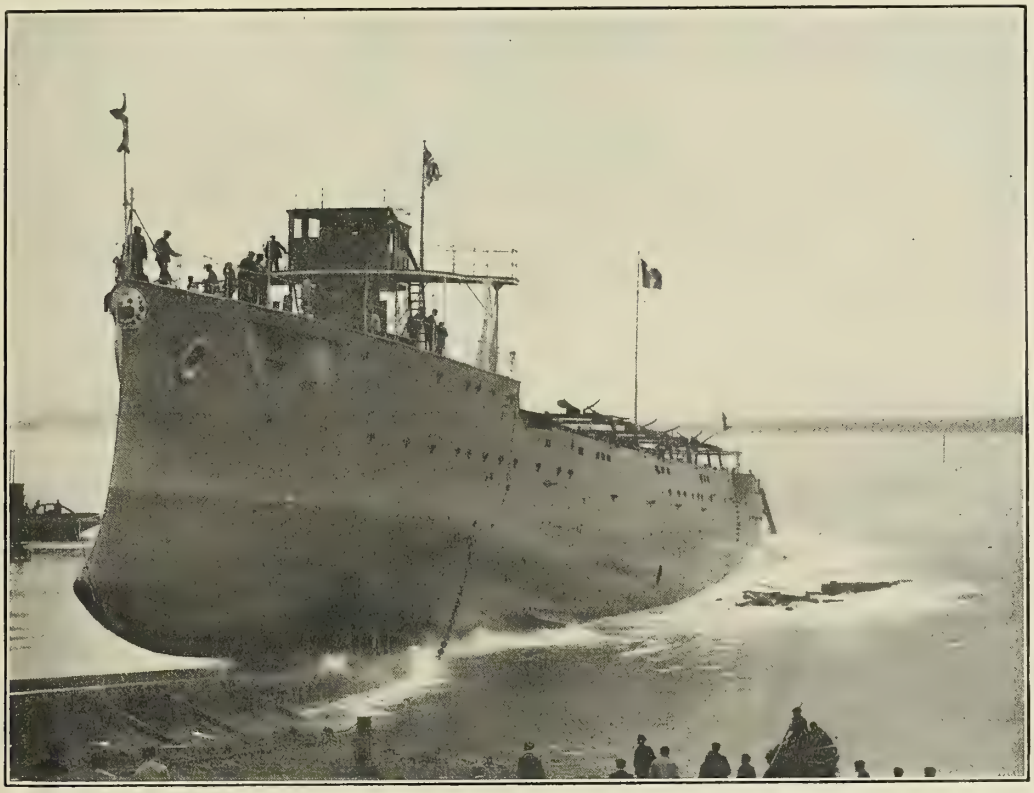
PERUVIAN CRUISER ALMIRANTE GRAU AT FULL SPEED ON TRIAL TRIP.

The trials of the *Almirante Grau,* which have been concluded were arranged to insure that the vessel should be able to steam at sea under all weather conditions at twenty-two knots, to make when necessity arises twenty-four, and to be able to cruise at a low speed with a light consumption of fuel. On the trials on the Clyde the vessel averaged, on full power, over twenty-four knots with the boilers working under normal conditions; the coal consumption was lower than the average of the eight new scouts for the British navy; and no difficulty was found in realizing twenty-two knots with only eight of the ten boilers.

The trials occupied a week on the Clyde. The first test was a series of progressive speed trials over the measured mile at Skelmorlie, and the results were up to expectations. On the measured mile she steamed 24.64 knots, and considerably exceeded twenty-four knots throughout the full power trial, the mean power being 14,144, while the revolutions were 216 per minute. The admiralty "constant" was 229. The continuous sea speed trial was equally satisfactory. The Peruvian government desired that this trial of twenty-four hours' duration should be divided into four successive periods of six hours at progressive powers, viz., 900 horsepower for the first six hours, 3,600 for the second six

hours, 6,000 for the third six hours, and 8,500 for the fourth. The coal consumption at low powers is, of course, higher, because the proportion of steam to be generated for the auxiliary machinery is greater than on a high power trial. At low power more than one-third is needed for auxiliaries, whereas on a full power run the proportion may be less than one-tenth. The coal consumption ranged between 2.27 pounds per horsepower for the low power to 1.635 pounds for the high power—all within the guaranteed conditions. This coal consumption trial was completed at Barrow.

until a more powerful ship is provided. Both cruisers are named after Peruvian heroes. The principal difference in the design of the two is that the *Almirante Grau* has a full poop to provide quarters for the admiral; in the *Coronel Bolognesi* there is only half a poop. Both ships have a length of 370 feet and a breadth of 40 feet 6 inches. The displacement of the *Coronel Bolognesi* is about 3,180 tons, with a draft of 14 feet 2 inches, and a block coefficient of 0.525; the *Grau* draws an inch more, and displaces 3,200 tons. The design called for 24 knots, with 14,000 horsepower.



PERUVIAN CRUISER CORONEL BOLOGNESI, LAUNCHED AT BARROW.

The *Coronel Bolognesi*, on trial, made 24.726 knots, with the engines indicating 14,384 horsepower, at 218.7 revolutions per minute. The admiralty "constant" was 228.

Each ship has a bow and stern chasing gun of 6-inch caliber, with an arc of train of 270 degrees, and in addition there are eight 14-pounder quick-firing guns, eight 1¼-pounder guns, with two submerged tubes for firing 18-inch torpedoes. She has for protection a deck of 1½ inch thickness extending the full length, and the conning tower is of 3-inch armor. The armor and armament have been made at the Vickers Works, at Sheffield.

The engines are of the twin screw four-cylinder triple expansion type, balanced on the Yarrow, Schlick, Tweedy system, and designed to develop 14,000 horsepower with steam at a working pressure of 250 pounds at the engines and 280 pounds at the boilers. There are ten watertube boilers of the small tube type, arranged in three separate watertight compartments, to work under forced draft on the closed stokehold system.

Special care has been devoted to the natural and artificial ventilation of the ship, and to the heating, steam radiators being extensively employed. There is, of course, a complete installation of electric light. Although the ship is small, baths are provided in all the living quarters. Refrigerating plant and ice-making machinery, with cold storage chambers adjoining, are notable features. There is also a mechanically equipped bakery on board, so that the vessel excels many warships of much greater size in the elements conducing to comfort.

The *Almirante Grau* will be the flagship of the embryo navy,

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of February 11, 1907, the following percentage of completion of vessels building for the United States Navy:

			Jan. 1	Feb. 1
BATTLESHIPS.				
Nebraska	19 knots.	Moran Brothers Co.	98.1	98.78
Vermont	18 "	Fore River Shipbuilding Co.	97.5	99.
Kansas	18 "	New York Shipbuilding Co.	96.9	97.4
Minnesota	18 "	Newport News Co.	98.5	99.
Mississippi	17 "	Wm. Cramp & Sons.	70.68	71.72
Idaho	17 "	Wm. Cramp & Sons.	66.78	67.87
New Hampshire	18 "	New York Shipbuilding Co.	60.8	61.8
South Carolina	19 "	Wm. Cramp & Sons.	5.08	6.32
Michigan	19 "	New York Shipbuilding Co.	3.01	5.9
ARMORED CRUISERS.				
California	22 knots.	Union Iron Works.	97.4	97.8
South Dakota	22 "	Union Iron Works.	94.8	95.2
North Carolina	22 "	Newport News Co.	69.16	71.56
Montana	22 "	Newport News Co.	63.59	66.05
SCOUT CRUISERS.				
Chester	24 knots.	Bath Iron Works.	59.42	64.18
Birmingham	24 "	Fore River Shipbuilding Co.	56.6	59.
Salem	24 "	Fore River Shipbuilding Co.	56.5	59.2
SUBMARINE TORPEDO BOATS.				
Cuttlefish	.....	Fore River Shipbuilding Co.	90.	91.
Viper	.....	Fore River Shipbuilding Co.	82.72	89.1
Tarantula	.....	Fore River Shipbuilding Co.	92.	92.5
Octopus	.....	Fore River Shipbuilding Co.	81.1	88.5

THE BUILDERS OF THE TURRET STEAMER.

William Doxford & Sons, Ltd., Sunderland, have for years made a specialty of a type of construction known as turret steamers, and in 1905 turned out so large a number of these vessels as to obtain the first place in the output of tonnage in the world. There were twenty ships, agregating 86,632 gross tons, or an average of 4,332. In 1906 the output was second largest, being 25 ships, of 106,158 tons, or an average of 4,246. None of these ships was of under 1,900 tons, and three of them were of over 7,500 tons. The power fitted ranged from 1,000 to 2,800 indicated horsepower, the aggregate for 1905 being 34,050, or an average of 1,700; and for 1906, 39,100, or an average of 1,564. The construction in 1900 aggregated 34,829 tons. In 1901 there were ten vessels of 35,055 tons, or an average of 3,506; in 1902, eleven ships, 43,780 tons, average 3,980; in 1903, ten ships, 39,860 tons, average 3,986; in 1904, fourteen vessels, 53,050 tons, average 3,789 tons. The aggregate output for the seven years amounted to 399,364 gross tons, or an average of 57,052 tons each year.

It is claimed for turret steamers that they are better sea boats than the ordinary type, and consequently make quicker passages in bad weather. Compared with ordinary models of vessels the registered tonnage of this type is said to be lower, both in cubic capacity and in dead weight, thereby enabling these steamers to carry a larger amount of freight with a lower working cost. This is said in some instances to amount to a difference of 5 percent. The freeboard given these steamers amounts to a greater quantity than that given the ordinary steamer, which makes them drier ships, prevents the decks and hatches from being damaged by the sea, and conduces to greater comfort of the crew. Full cargoes of grain can be loaded in bulk, thus saving cost and loss of time. Trimming charges for grain and coal are lower than in the usual type of ship, by virtue of the form of the hold into which the cargo is placed. When carrying cattle, the cattle deck is about 11 feet above the load line, and 10 feet inboard from the side of the ship, as against a height of 5 or 6 feet on the ordinary tramp steamer, and with the deck carried right up against the ship's side. This is said to enable the turret to carry cattle and sheep in better condition and with less loss of life.

GENERAL VIEW OF THE SHIPYARD OF WILLIAM DOXFORD & SONS, LIMITED, WITH NUMEROUS TURRET STEAMERS UNDER CONSTRUCTION.

THE RIVER FRONT AT LOW WATER, SHOWING CONSTRUCTION IN PROGRESS ON THREE SLIPS.

The yard was started at Pallion in 1857, the present site having been cleared in 1869. In 1878 the engine-building department

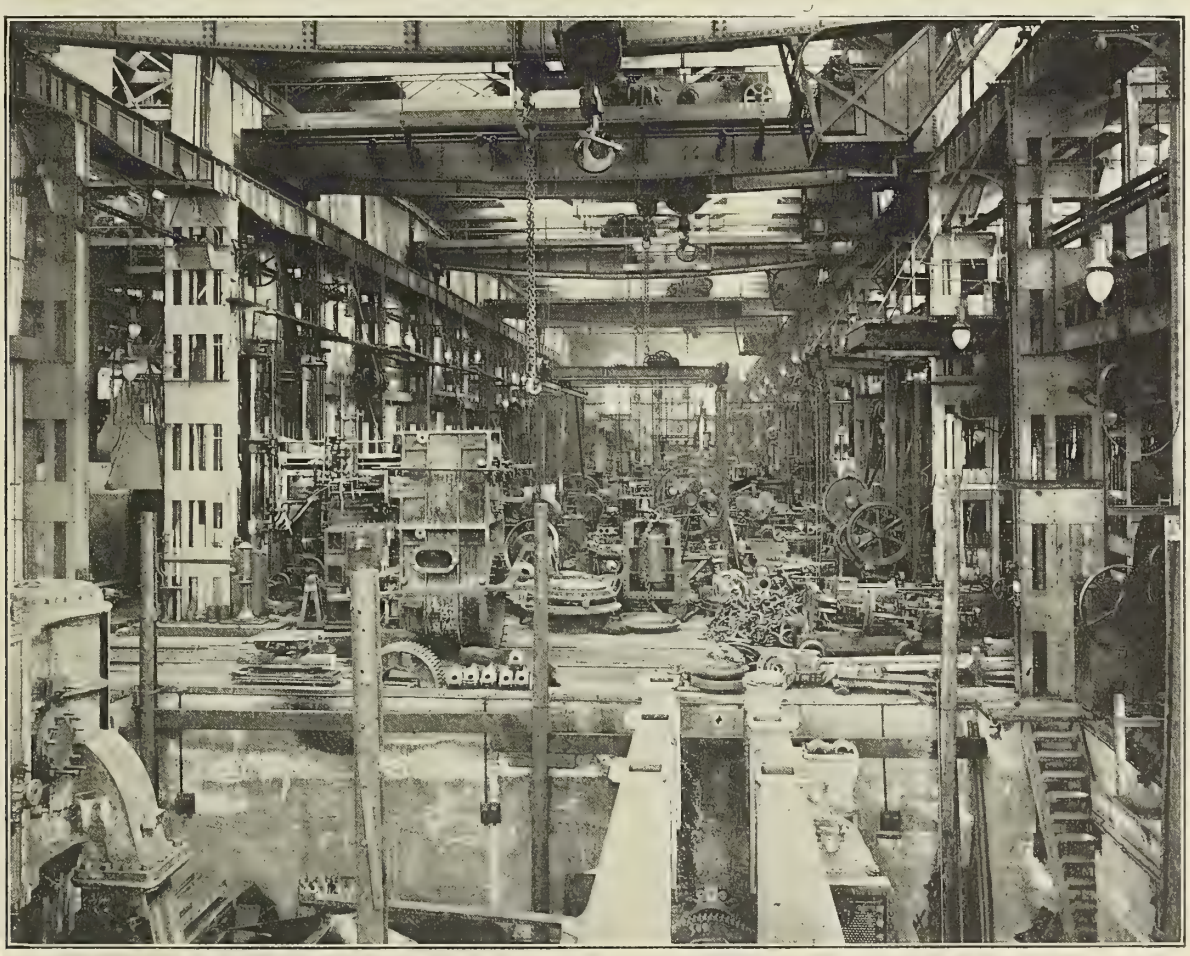
was added, and for many years steamers of the ordinary type were built and fitted with machinery. In 1891, when the capacity of the yard was about 28,000 tons per annum, the partnership was converted into a private limited liability company with a capital stock of £200,000 ($973,300.).

About this time the turret ship began to be developed. The first of these steamers was launched before the end of 1892, and at the present time nothing else is built in the yard. Up to the end of 1905 there had been completed no less than one hundred and twenty-nine ships of this type, the secret of the success of which is said to be a combination of lightness and strength. This lightness is achieved partly by the rounded corners fitted, thus saving the weight of the angles in the ordinary type, and partly by the large amount of flanging adopted in the construction, and in the joggling of plating for the hull, thus dispensing with large weights in heavy liners and backing. This system gives great longitudinal strength, and by substituting deep frames for all internal supports has enabled the builders to dispense with beams and girders and obtain a clear hold. By this method of construction it is said that 58 cubic feet per ton dead weight under the hatches is secured in the turret steamer, as compared with about 53 cubic feet in the ordinary type.

During the period of development of the turret steamer there were gradually added to the establishment large amounts of extra machinery, together with a fitting-out quay with a 150-ton

TURRET STEAMER IN FRAME, IN THE DOXFORD SHIPYARD.

thoroughly up to date. Such rapid progress was made that in three months after the fire the new shops were again at work. The capacity is now about thirty sets of marine engines per year, with an indicated horsepower of 45,000. The engineering department includes boiler shops, making the establishment com-

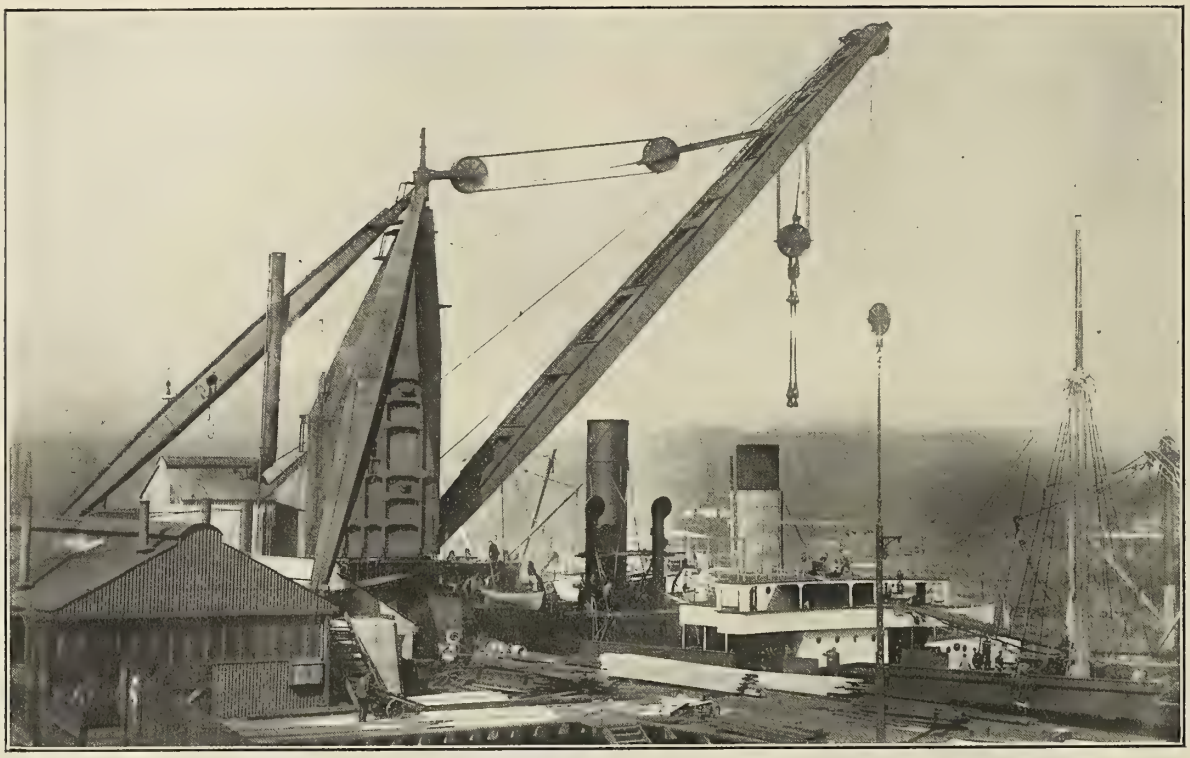


GENERAL VIEW IN THE ENGINE ERECTING SHOP OF THE DOXFORD SHIPYARD.

radial crane, and proper railway accommodation. Additional land was purchased and new slips laid down, besides which the original five small slips were converted into three of large size, until now there are six of these large slips, each capable of accommodating a vessel of as much as 12,000 tons dead weight carrying capacity.

In 1901 the engine works were destroyed by fire, and advantage was taken of the necessity of putting in new works to bring them plete and comprehensive. In 1902, the entire plant was equipped with electric drive, and so complete has been the transformation that at the present time even the power for hydraulic and pneumatic pressure is secured by means of electric motors, a portion of the electric energy being derived from local power companies.

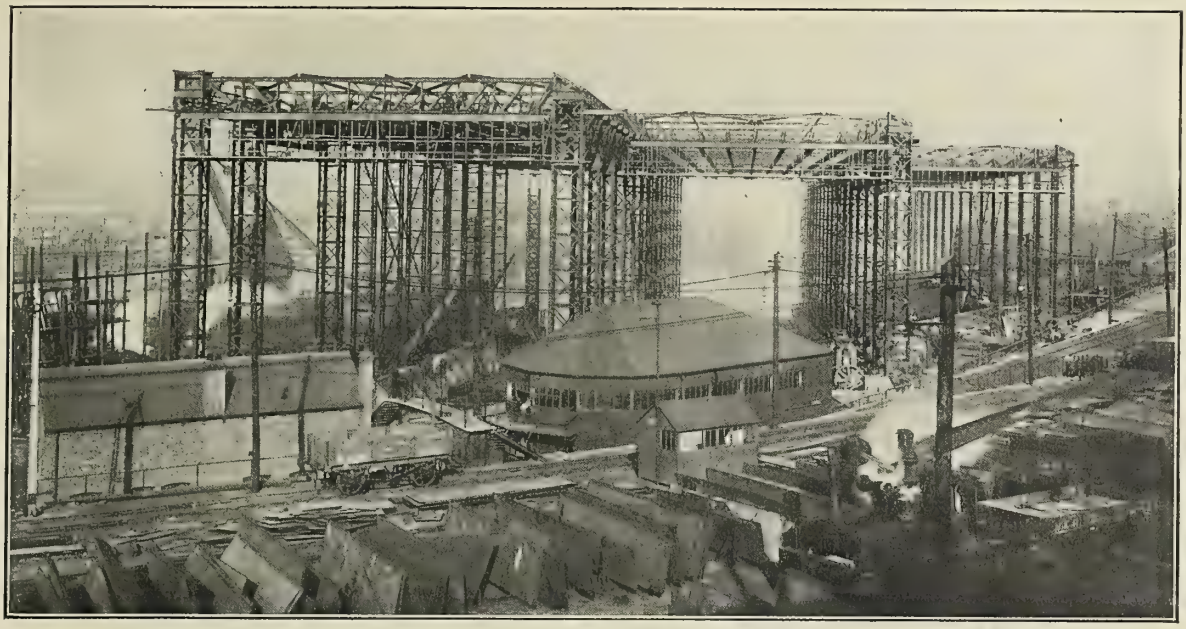
In laying out the three latest slips, the formation of the ground was such as to necessitate a special design of yard. The banks of the river rise to a great height from the low water mark, so



THE 150-TON CRANE PUTTING REFRIGERATING MACHINERY ABOARD THE STEAMSHIP KELVINDALE.

that the slips were actually designed to all appearances like graving docks. The whole of the machinery space where the work is prepared is on an elevated terrace, considerably above the building level. This has proved a striking advantage, because of the fact that material can be lowered into its place with the assistance of gravity instead of having to be raised to its position in the ship as in the ordinary case. These building slips have a unique arrangement of overhead gear, surmounted by vertical lattice work columns and beams, which carry nine girder tracks above each vessel. On these tracks are the hoisting trolleys, each of a capacity of three tons and driven by electric power. These overhead tracks project beyond the vessels at both ends. The type of steamer here constructed lends itself particularly to template work. As a result, very large portions of the vessel are prepared before the keel is laid, and as soon as a slip is cleared from the previous ship, work on a new vessel proceeds

INTERIOR VIEW OF BOILER SHOP IN SHIPYARD OF WILLIAM DOXFORD & SONS, LIMITED.



TRANSPORTER ERECTIONS OVER SUNKEN BUILDING BERTHS SHOWING METHOD OF HANDLING MATERIAL.

with great rapidity, sometimes a single day seeing the whole of the bottom plating, keel and keelsons of the new ship in place.

The engine and boiler shops are 350 feet long and consist of four bays, two of 49 feet span and two of 32 feet span. Each bay has four overhead traveling electric cranes. The wider bays have crane capacity permitting the transportation of weights up to 80 tons. In the machine shop are powerful lathes and planers driven by electric motors, the largest planing machines being able to handle an engine bedplate 20 feet square.

The electric generating plant consists of four units, each of 250 horsepower, driven by triple expansion surface condensing vertical engines operating at 160 pounds pressure per square inch. This furnishes the entire power for the west section of the yard. Current for the east section is taken from private mains.

The *Navy League Journal* is authority for the statement that the Russian navy has twelve admirals, fourteen vice admirals, twenty-seven rear admirals and eight battleships. This calls to mind Secretary Taft's visit to the Isthmus of Panama, when he is reported to have been met by the entire army, which consisted of seventeen generals and one private.

THE BOILER YARD AND PLATE STOCK YARD, WITH BUILDING SLIPS IN BACKGROUND.

THE RAILWAY TYPE OF DRY-DOCK.

BY JAMES L. CRANDALL, C. E.*

The tendency throughout the shipping world to look upon the "Marine Railway," or "Patent Slip" as it is called in Europe, as a cheap substitute for a dry-dock, and therefore unfit for docking anything but small vessels, is quite well known, and has naturally grown out of the fact that the old "railway" or "slip" was indeed such a substitute. Because of this it has also appeared natural to regard any type of dock working on the principle of the inclined plane as a makeshift. This, however, is by no means true, and it will be readily seen that a dry-dock can be such as truly, whether it removes the vessel from the water by direct vertical lift, as with the hydraulic and the floating types, or by traveling up an incline, as with the railway type; or by removing the water from about the vessel, as with the basin or graving type. In other words, the mere method of removing the vessel from the water, or the water from about the vessel, is but an incident of the type adopted, and does not affect its title to the name of dry-dock. The last twenty years have seen the development of a thoroughgoing dry-dock, operated on the incline lift principle, until to-day the "railway dry-dock," as it is now called, is long past the stage of experiment.

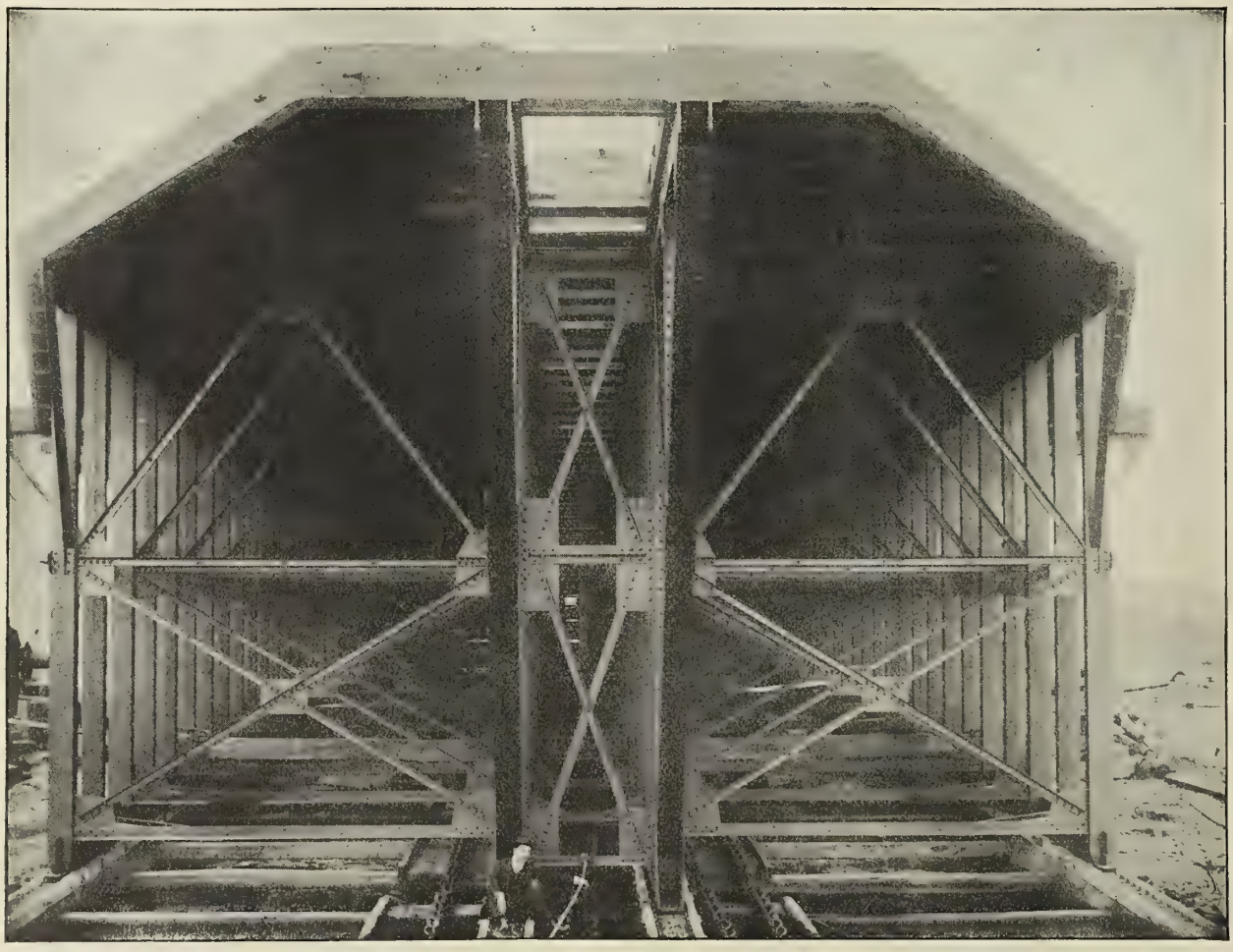
It may be interesting to analyze to some extent the essential features of a good dry-dock, and to notice the extent to which the railway type fulfils them. The primary function of a dry-dock is to give access from the outside to those parts of a vessel which lie below the waterline. To accomplish this purpose two essential requirements should control the design and construction of any type of dry dock:—

First—Adequate provision for supporting the weight of the vessel, and the proper distribution of these supports in order to avoid injurious strains; and

Second—The vessel must be so berthed and supported that all parts of her bottom will be readily accessible for the performance of the work for which she was removed from the water.

Any appliance which fulfils these conditions is certainly a dry-dock, and to differentiate between the merits of different types is to measure them according to the degree of safety provided for this first requirement, and to the degree of efficiency with which they fulfil the second requirement.

While many types of dry-dock have at various times been used, the trend of modern practice has been almost wholly toward three, namely: the basin dock, the floating dock and the railway dock. The evolution of these three types is obvious. Each began with a crude and simple application of its principle, sufficient for the small vessels then in use. When a certain Phenician in the third century B. C. dry-docked the great galley of Ptolemy Philopater, by excavating an inlet into which he floated the galley, and then removing the water in the inlet, after damming the mouth, he applied the fundamental feature of a basin dock. A certain British sea captain, about two hundred years ago, being caught in a remote harbor with a leaky ship, dry-docked his vessel by cutting off the stern of an old and large hulk so that he could float his vessel in through the open stern. He then closed the stern and bailed out the water, and in so doing applied the great feature of the floating dock. And when, from time immemorial, our seafaring forefathers dragged their smacks up an inclined beach, they applied the essential lifting feature of a modern railway dry-dock. The increase in the size and weight of vessels gradually compelled better design, until, from this



VIEW OF THE OUTBOARD END OF A RAILROAD DRY-DOCK, SHOWING STRUCTURAL BRACING.

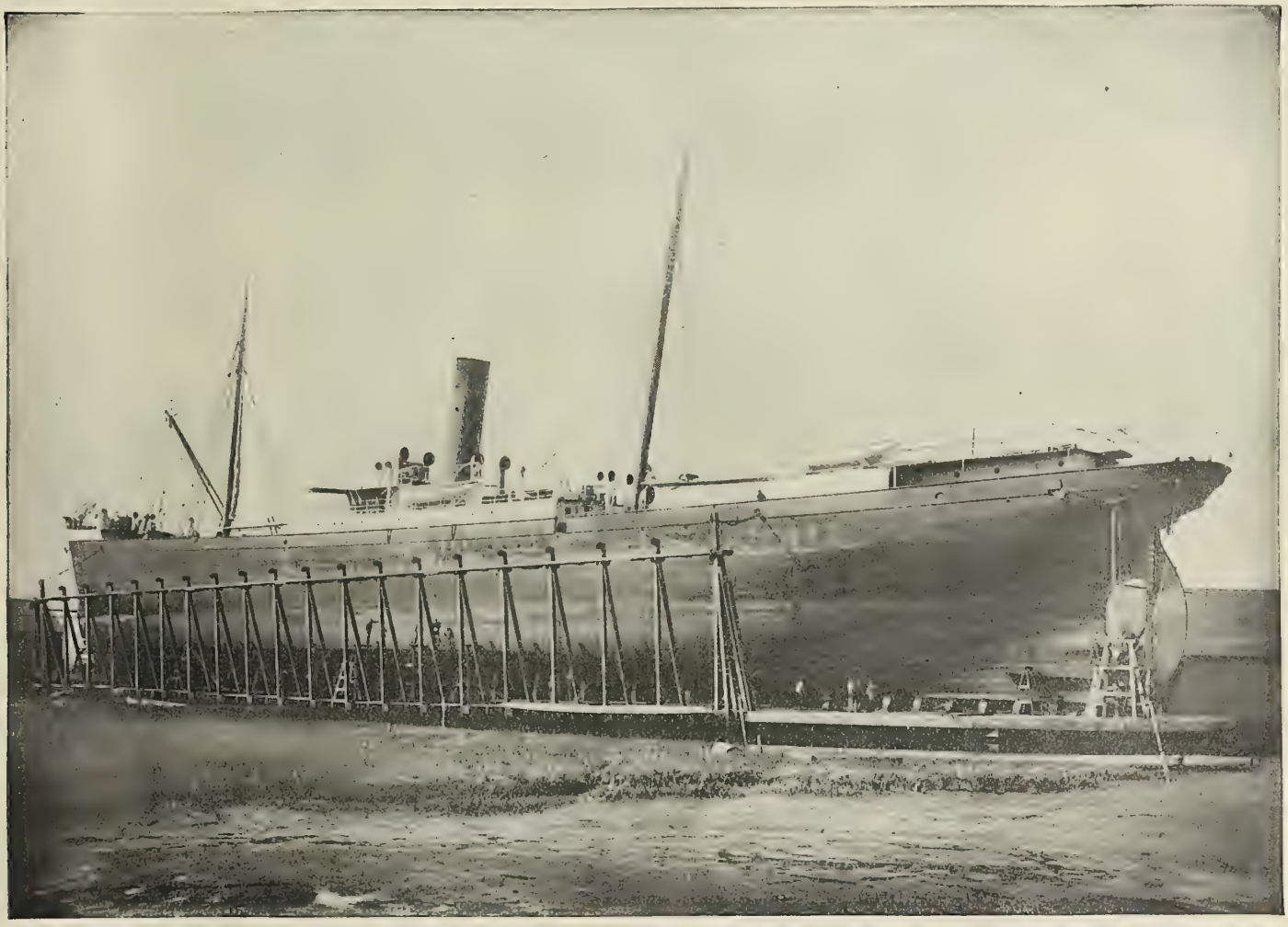
*President, The H. I. Crandall & Son Co., East Boston, Mass.

development, each of these types in its most modern form embodies the most careful and able engineering.

Broadly stated, a railway dry-dock is a fully equipped dry-dock, which travels down an incline beneath the water until the vessel can be floated over it, and is then hauled up the incline with the vessel upon it until the floor of the dock is well above the water. To those unacquainted with this type of dock, the question naturally arises as to whether or not it fulfils the essential requirements of a thorough dry-dock.

The first requirement, as stated above, is: "adequate provision for supporting the weight of the vessel, and the proper distribution of these supports in order to avoid injurious strains." It is almost axiomatic, that the vessel when removed from the water should be supported practically in the same manner as when she is afloat; and also that there should be no yielding of the supports when subjected to the vessel's weight. In other words, when the supports are once fitted to the vessel's shape, they should form an unyielding bed for as long a time as she may rest upon them. It has been sometimes contended that a vessel, being a structure built to resist the varying strains due to the unstable medium in which her life is passed, does not require unyielding support when dry-docked. Such, however, is not the case; for while a shipowner must submit his vessel to the racking of heavy weather which he cannot avoid, he does not and should not willingly court damage from injurious strains upon an inadequate dry-dock, which he can avoid. The only thoroughly safe principle for a good dry-dock, is a practically unyielding base for the direct supports of the vessel, and in the railway dry-dock this is provided for by adequate foundations, which in common with the basin or graving dock, depend upon the geological nature of the site upon which it is built. If a foundation can be obtained for the one type, it can equally be obtained for the other.

With foundations of adequate strength the element of uniformity of support is assured by building the "track," which rests on these foundations and upon which the dock travels, to a true gradient, so that the dock cannot change in its alinement under the vessel, in passing up and down the incline. Thus, if the keel-blocks are laid in a straight line for a straight keeled vessel, the dock will maintain them in that straight line throughout its entire travel. With regard to the direct supports of the vessel, the best system beyond question is the bilge block system, which is very generally used in the United States, and almost exclusively used in the railway dry-dock. This system gives support along the whole length of keel and both bilges, and approximates very closely to the support the vessel receives from the water when she is afloat. The adoption of the bilge block system for the ships of the United States navy is quite well known, and its merits too evident to need elucidation here. It is sufficient to say that a well designed keel and bilge block system can scarcely fail to give the best of satisfaction in a dry-dock. These facts as to foundations and supports being thus assured, there can be no doubt that the railway dock fully meets this first condition for a true dry-dock, granting the one thing essential in common with every other type, viz.: good engineering.



GENERAL VIEW OF A RAILWAY DRY-DOCK WITH A STEAMER ON THE KEEL-BLOCKS.

In the next place, does the railway dry-dock meet the second great requirement, namely: "to so berth and support the vessel that all parts of her bottom are readily accessible for

the performance of the work for which she was removed from the water?"

In all dry-docks the vessel is first "grounded" firmly on the keel-blocks, and the bilge supports applied before the support of buoyancy has been diminished to any practical extent. This being done, it remains to place the vessel entirely clear of the water, as quickly as is practicable—either by removing the water from about the vessel or lifting the vessel from the water, according to the type of dock employed—she being in her final position ready and accessible for work. In the basin and floating docks this operation is performed by means of pumping machinery. In the hydraulic dock it is done by direct lifts, which take the entire weight of both vessel and dock. In the railway dock it is accomplished by powerful hoists, which take part of the total weight in hauling the dock up the inclined track. In all dry-docks, it is simply a matter of engineering to obtain the proper results in point of safety and time. In this latter operation, however, a great difference appears between the several types of dock under consideration, in the time or horsepower involved, which difference is of more importance from the commercial standpoint than is usually appreciated.

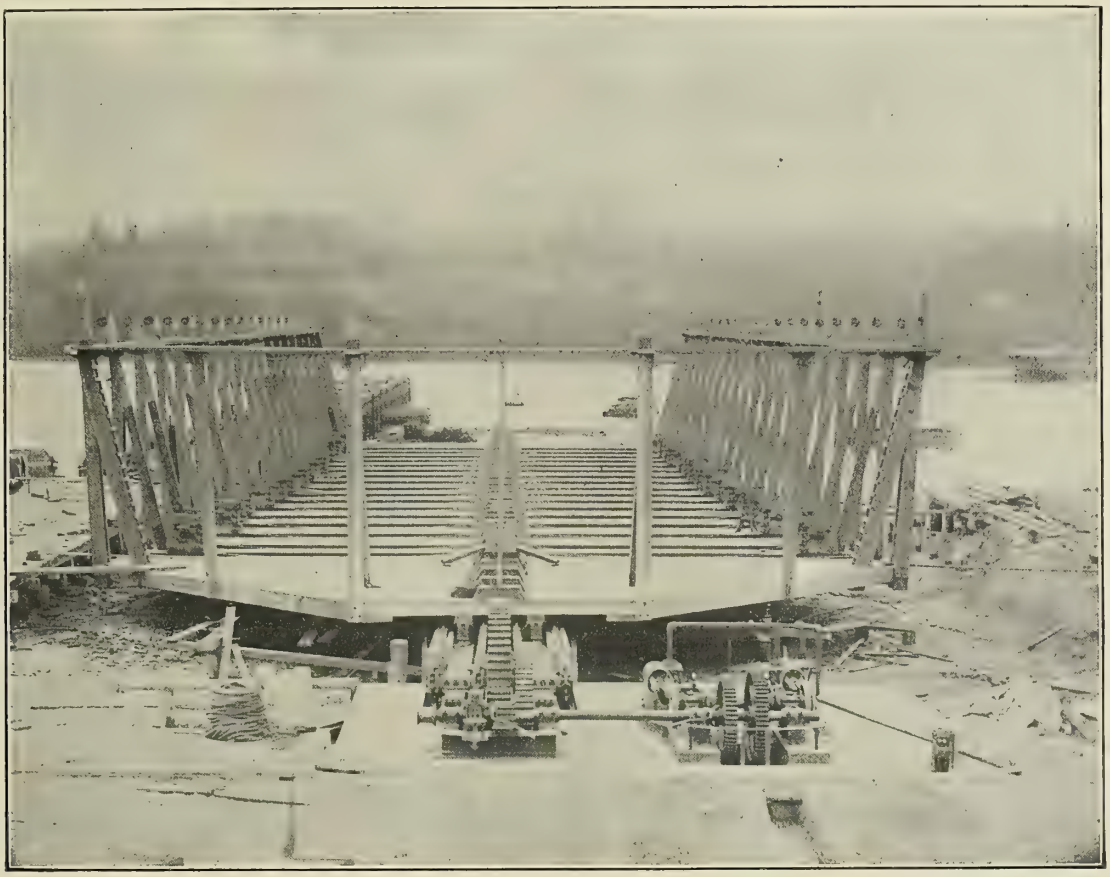
Assuming that it takes five hours, which is often the case, to place a 4,000-ton vessel in a basin dry-dock ready for work, it follows that but four hours remain from a nine-hour day for work on the vessel. Comparing this with a dock taking but three hours for the same, it would leave six hours for work on the vessel, or 50 percent more, while the labor cost of docking the vessel is forty percent less, assuming the same number of men to be employed. With some of the latest docks, especially the railway dock, this time is reduced to about one hour or less. Comparing the last period cited with the first, the labor cost is but 20 percent, while there is 100 percent more time left from a nine-hour workday for repairs to the vessel. Since most of the cost of dry-docking a vessel is the labor cost, the effect of this time element on the total cost of docking is obvious.

Outside of that portion of this docking time which is consumed in centering and "grounding" the vessel—which is practically common to all types of dock, and is a question of the ability of the dock master—the time depends on the horsepower supplied in the pumping or lifting machinery, which simply amounts to a difference in first cost in any one type of dock. The difference, however, in the amount of horsepower required by the several types of dock for the *same lifting or pumping period* is great, and consequently the amount of fuel cost, which with the labor cost constitutes practically all the docking cost, varies in proportion. With the basin dock this pumping and docking cost is greatest, and with the railway dock it is least. To this must be added the fact that leakage in the docks which depend upon pumping is often of a considerable amount, and in some cases calls for constant operation of an auxiliary pump. Per contra, when once a vessel is docked on a railway dock this fuel expense ceases. For instance, a certain concrete basin dock nearly 600 feet long consumes 6 tons of coal in pumping out once, and an additional ton per day to remove leakage water. With a railway dock of the same size the fuel cost is but about one ton per vessel, besides the fact that the vessel can be docked in about

INSHORE END OF DOCK IN SERVICE, SHOWING HAULING GEARING.

one-quarter of the time. When it is remembered that this difference in point of time expended or horsepower involved means less first cost, less operating expenses, and increased earning capacity, its effect on dividends is obvious. There are many instances of much quicker docking on railway docks; as for instance, a case where it took but twenty-five minutes from the time the dock was started down until it was back in place, with a 1,600-ton vessel on it ready for work. On some small railway docks the lifting time is but from one to two minutes from the grounding of the vessel.

for men and for supervision. All modern dry-docks have good floors, but these floors differ much in their position with relation to the yard. The floor of a railway dock is virtually on a level with the adjacent yards, and as it is open on both sides as well as both ends, materials can be deposited on it from yard trams at any point on either side, and within a few feet of where they are to be placed in the vessel. In the same manner plates, etc., going from the vessel to the shop, can be readily placed on trams at any point on either side, with a minimum of handling. Staging can also be handled to



INBOARD END, SHOWING GEARING FOR OPERATING THE DOCK, AND STRUCTURE OF CRADLE.

After the vessel is docked other conditions prevail which may be classed as the "efficiency of the dock," upon which depends the rapidity and the facility with which the work can be performed, and which forms an essential element in the cost of the work done:

(1) There should be ample freedom about the dock to give access to all possible light and circulation of air, in order that bottom surfaces may dry well and quickly, and that work upon the bottom may be done to the best advantage. These points have not received all the attention they deserve, for it is one of the drawbacks of the basin dock, that when a large vessel occupies it the deficiency of light under the bottom, and in warm weather the lack of circulation of air, render it practically impossible for men to do a fair day's work. In contrast to this, the railway dry-dock places the vessel above the surface of the surrounding yards, and is open on all sides to light and air, with nothing to obstruct circulation. In fact, there is no modern type of dry-dock that is equal in this respect to the railway dry-dock.

(2) It is essential to have a good working floor to the dock, as free from obstruction as is compatible with sufficient support for the vessel. This floor should be in the most convenient position relative to the yards alongside, in order that staging materials and tools may be placed where needed, with a minimum of labor, and also in order to be easily accessible and from the yard or from piers alongside with the least amount of labor. Men can step directly from the dock floor to the yards, and almost the whole work going on upon one side of a vessel's bottom can be seen by a foreman or superintendent standing in the yard alongside. The railway dock in this respect is superior to any other type of dry-dock now in use.

(3) The bilge supports should be easily removable for painting, etc., and the dock must have sufficeint strength for the weight of the vessel to be carried on it by shores, etc., independent of the keel, in case the keel blocks have to be removed. Both are accomplished in the railway dock as in other types, the former by use of releasing bilge-blocks, and the latter by providing for it in construction. These three points of efficiency are well illustrated in the photographs, which exhibit the general features mentioned, and two of which exhibit some of the structural features.

It is obvious that not only does the railway dock meet the second main requirement of a true dry-dock, but it does so to a greater degree of efficiency than any other of the prevailing types. When to this is added the fact that the railway dock costs less to build, less to operate, and is operated more quickly than any other of the prevailing types, the aggregate of advantages from a commercial standpoint is manifest. That the foregoing facts are being recognized on all sides is proved

by the fact that they are being adopted in competition with the other types for all classes of vessels, both in the United States and in Europe.

OUTER END OF DOCK CARRYING A LARGE SAILING VESSEL.

Torpedo boat plates have been giving the British Admiralty some little concern, and it is reported that the Admiralty is seeking for plates which, while having the strength and comparative lightness of those now in use, will be able to better withstand the destructive agencies operating in salt water. It is said that several British firms making a specialty of armor plate have been asked to experiment, looking towards the improvement of plates for torpedo craft. This appears to have been rendered necessary by the discovery that plates on the latest destroyers and torpedo boats have been eaten away so seriously in a single cruise as to impair their utility.

The annual report of Webb's Academy and Home for Shipbuilders for the fiscal year 1906, shows a prosperous state of affairs, the total receipts, mainly from rentals, having amounted to $101,153, and the disbursements $58,460. The surplus was added to a previous balance of $64,611, leaving a total on hand of $107,304. The number of guests in the home remains at forty-six, as last year. The number of students in the Academy has decreased from forty-two to thirty-eight.

Wanted—Safer Ships.

BY ROBERT H. KIRK.

The recent disaster to the steamer *Larchmont* on one of her regular trips through Long Island Sound is typical of disasters that have preceded it, and it may safely be prophesied that unless suitable restrictions are placed upon the construction of passenger ships, disasters of this character will be more frequent in the future than they have been in the past. This would be the logical result of increasing traffic and more crowded harbors. Added speed and regularity of service in water transportation is demanded, and this means that the service must be carried on in all sorts of weather. All this increases the dangers of navigation, and lends added weight to the demand for legislation, state or national, or both, compelling such improvements in construction as will make passenger vessels as *safe as possible.*

Disasters even near shore and in tolerably favorable weather have shown the inability of the crew to safely land the passengers from a sinking vessel. What this might be in case of severe weather can be readily estimated. And it is certainly only reasonable that the lives of the traveling public should be as carefully guarded as possible, and that provision for their safety should not depend any more than necessary upon the crew of the vessel.

When iron ships came into use, and the idea of subdividing the hull into numerous watertight compartments became generally accepted, it was realized that a ship could be rendered practically safe, so that even though she struck upon a rock or sustained injuries in a collision, which would result in flooding one of her watertight compartments, buoyancy would not be lost, and she could probably reach port in safety.

The advantages of watertight compartments are very generally appreciated, and the feeling of safety upon shipboard is, in a measure, due to the belief that the use of bulkheads is general. As a matter of fact, the proper subdivision of the hull of a passenger ship is the exception rather than the rule. Of course our great ocean liners are usually well built in this respect, and this is largely due to the fact that the majority of them have been constructed where the rules and regulations require watertight compartments of sufficient number to render a ship safe.

Ships built in the United States are quite likely to be deficient in this respect, for it is, even today, a matter which rests largely in the hands of the shipowner. The safety of the public is carefully guarded upon shore by numerous well-defined regulations governing the construction of buildings, use of fire escapes, and the like, and even upon shipboard the construction of the boilers is covered by rather complete regulations designed to secure safety.

That the regulations requiring proper subdivision of the hull into watertight compartments are extremely lax and inefficient in their action will probably not be denied by men familiar with the practical conditions. Steel ships are built today for use in our harbors and along the coast, in which the system of bulkheads cannot have been subject to serious calculation, for in some instances it has been considered sufficient if the ship is provided with a collision bulkhead forward and another aft. This was the case in the *Larchmont.* If a ship happens to have a sufficient number of bulkheads, it is probably due to the desire of her owner to have her perfect in this respect; but such instances are unusual, for the reason that bulkheads cost money, and they do not increase dividends. We consequently depend upon the human element in the owner to spend enough money upon his ship to make her safe.

It is also to be considered that in order to properly operate a ship it is necessary to have doors between the principal compartments, and that these doors, in themselves, are an element of weakness in the bulkhead system. That the majority of the watertight doors are useless in emergencies will not be denied, for though the doors themselves may be all right, they depend

wholly on the ability of the crew to close them in case of accident, and experience has proved that the crew will not and cannot do it. Even this difficulty has been overcome, however, and to the American navy belongs the credit for demanding a door which should not depend upon the crew for proper closure, but which is so arranged that all the doors of the ship may be safely closed by power by an officer located upon the bridge, where danger is first realized. The navy is equipped almost entirely with these "Long Arm" doors, and their use has proved successful beyond expectation.

In view of these facts, the increasing dangers of water transportation, and the known, tried and proved methods by which ships may be made safe—is it not time for legislation which will *require* such watertight subdivision of ships that hull puncture will not mean the loss of ship and human freight? If the building and design of ships were carefully regulated, we should rarely have disasters like that of the *Larchmont.*

THE FREIGHT STEAMER TUSCAN, BUILT AT SPARROW'S POINT BY THE MARYLA

THE NEW AMERICAN FREIGHTER TUSCAN.

BY GEORGE JENKINS.

One of the latest additions to the fleet of the Boston & Philadelphia Steamship Company is the steamer *Tuscan,* which has just been completed at the yard of the Maryland Steel Company, Sparrow's Point, Maryland. She is a single screw steel freight steamer of the spar deck type, built to the highest class of American Bureau of Shipping.

As will be seen in the illustrations, she has a forecastle for the crew, and a deck-house amidships for officers, with no passenger accommodations. Like other ships of the company, she is rigged as a two-masted schooner, with steel poles well raked. She was built especially for the freight trade between Boston and Philadelphia, and is fitted with all the necessary appliances for quick and easy handling of cargo.

Her principal dimensions are:

Length over all	290 feet
Length between perpendiculars	274 feet
Beam molded	42 feet
Depth molded	28 feet 3 inches
Draft	16 feet
Sea speed	15 knots

HULL CONSTRUCTION.

The *Tuscan* is a single bottom ship, with two complete steel decks, and lower deck fore and aft of machinery spaces. She is built with continuous plate keel and keelson, the latter extending above floors, with rider plate on top. The flat keel is 33 inches by 33 pounds, reduced to 24 pounds. The center keelson is 37 inches by 22 pounds, connected to floors, keel and rider plate by 5 by 3½-inch by 14 to 12 pounds angle. The rider plate is 10⅝ inches by 22 pounds, and the floor stringers on each side of the center keelson are 18 inches by 21 to 17 pounds. The center line keelson is carried as far forward and aft as practicable, and is rigidly connected to the stem. The latter is made in one piece, shaped to suit the keel, of the best hammered scrap iron, 9¾ by 3 inches.

The stern frame and rudder frame are made of iron in one forging. The stern post is 10 by 6 inches and the rudder post is 10 by 5 inches, with pintles forged on. The rudder is of the single plate type, with stock 7¾ inches diameter, and is supported on three pin pintles, all fitted with brass bushings, working in lignum-vitae. The weight of the rudder is carried on a bearing built up inside the hull.

The *Tuscan* is framed with channels, reverse frames and solid floors fitted on every frame, the latter being 25 inches by 23 to 21 pounds, increased in engine and boiler spaces to 26½ pounds. In the engine room, deep floors are fitted to form the engine foundation. Frames are spaced 24 inches apart throughout the ship, and are continuous from keel to spar and forecastle decks. The frames are channels 6 by 3½ by 3½ inches by 15 pounds between end bulkheads, and reverse bars are 3½ by 3 inches by 8 pounds all fore and aft, to extend across top of floors only, double through engine and boiler spaces to upper turn of bilge. Double frames are fitted at all watertight bulkheads, and in machinery space.

Web frames are fitted on every eight, six and four frames in cargo, engine and boiler spaces respectively, and extend from floors in lower hold to under side of main deck. They are 15 pounds in hold, 12½ between decks, and on each side of ports 20 pounds.

There are three keelsons on each side in lower hold. The upper and lower keelsons have two 5 by 3½ inch by 13 pound to 11 pound angles, back to back. The side keelsons are of 15 pound plate fitted intercostally between floors, connected by single 3½ by 3½ inch by 8 pound angle, intercostal between frames, to shell, and double 5 by 3½ inch by 14 to 12 pound angle on top of floors. All keelsons run the full length of ship, and form breast-hook at stem. A stringer of 5 by 3½ inch by 12 pound angles is run between belts between main and spar decks.

The shell plating is of the raised and sunken type, with butts lapped and solid liners at frame in wake of outside strakes. The garboard strake is 25 pounds throughout; bottom plating 22½, bilge 23, and sides 22½, all reduced at ends. Main sheer is 28 pounds, reduced at ends, and spar deck sheer is 22½ pounds.

Double plates are fitted forward, for protection against ice and from damage by anchors. All butt laps are double riveted up to main sheer, which is treble riveted.

The spar deck beams are channels, 7 by 3½ by 3½ inches by 17½ pounds, on alternate frames. Main deck beams are channels 10 by 3½ inches by 28 to 26 pounds on alternate frames. The lower deck beams are 10 by 3½ inch by 26 pound channels on alternate frames.

The lower deck has a 38 inch by 19 to 15 pound stringer, double in way of ports, and is laid with 3½ by 3½-inch yellow pine decking with 1½-inch yellow pine sheathing. The main deck has a 48 inch by 20 to 16 pound stringer, with complete steel deck, 20 to 16 pounds. The spar deck has a 36 inch by 15 to 13 pound stringer, with complete steel deck. The lower and main deck stringer angles are 4 by 4 inches by 11 to 10 pounds, with 3 by 3-inch by 22 pound waterway angle, and the spar deck angles are 4½ by 4½ inches by 13 to 11 pounds. There are four hatches on the lower deck, four on the main, and three on the spar deck.

The hull is divided into five watertight compartments by four thwartship watertight bulkheads, one at the fore peak, one at the forward end of the boiler room, one at the after end of engine room, and one at the after peak. There is also a partial bulkhead between engine and fire rooms. A longitudinal coal bunker runs the entire length of boiler room and partly in engine room. The shaft alley is built of 12 pound plates, well stiffened by angles.

Bilge keels of 10-inch bulb angle, with angle 3½ by 3½ inches by 11 pounds, are fitted amidships.

Solid stanchions are fitted from keelson to lower hold beams, 3⅝ inches in diameter, from lower to main deck 3¼ inches diameter, and from main to spar deck, two lines of stanchions, 2½ inches diameter, secured under spar deck to a channel continuing from forward to after collision bulkhead. Spar deck rail stanchions are forgings, with galvanized iron pipe rails, made portable in ways of hatches; chain rail on forecastle.

There are two fresh water tanks of 5,000 gallons capacity. Two large ports between main and spar decks are located abreast of hatches, and one, between main and lower decks, is located forward. They are of the usual type for coastwise steamers. The hold is laid with 3-inch yellow pine ceiling, laid in shutters to upper turn of bilge. Cargo battens of yellow pine are also fitted.

The masts are 110 feet above keel, built of 22-pound plate stiffened by angles. The foremast is fitted with Oregon pine topmast.

The *Tuscan* is equipped with a Hyde windlass, the capstan drum being located on and operated from the forecastle deck. There is a steam power capstan installed in the lazarette, the drum being located on spar deck. Three Williamson double drum, double eye hoisters, one Williamson steam steering engine, and two cargo cranes are also fitted. The anchors are of the stockless type, two bower and one stream anchor. Life boats are supplied and fitted to conform with the United States Steamboat Inspection laws. One steam deck pump, 6 inches, duplex, is located on spar deck forward.

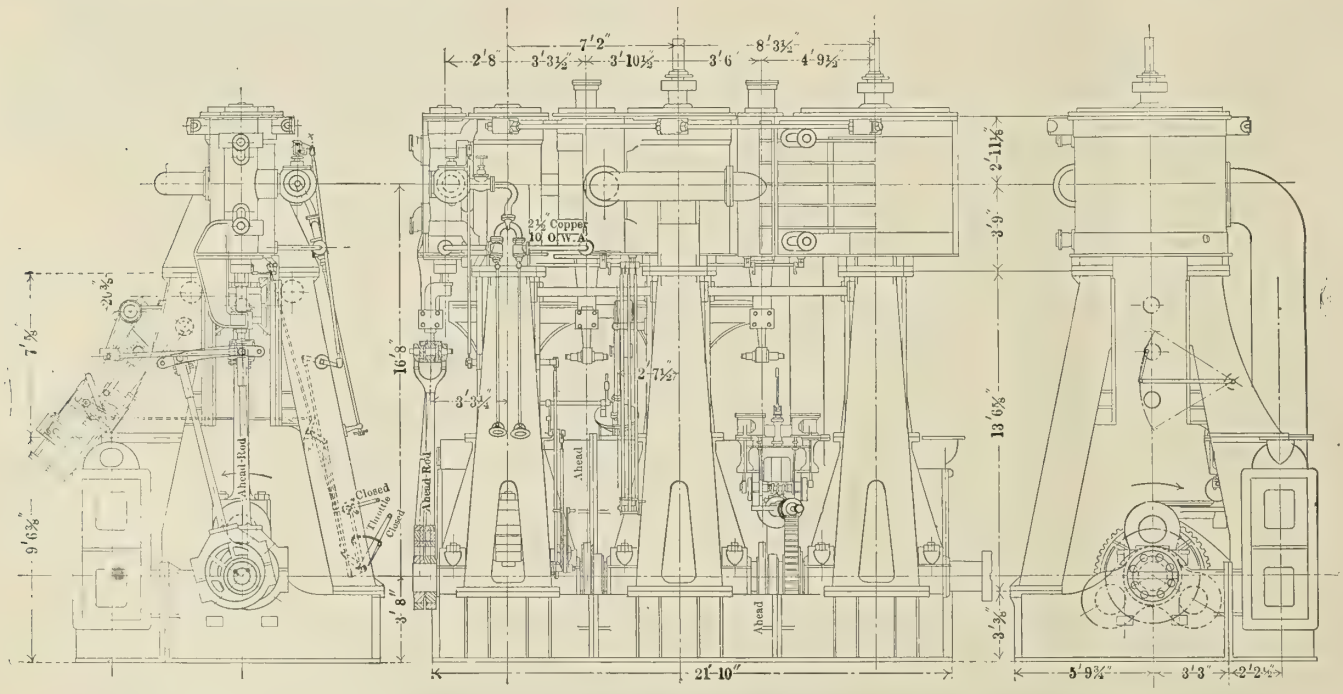
All quarters for officers are finished in cypress, the captain's quarters and messrooms being paneled.

MACHINERY.

The main engine of the *Tuscan* is of the direct acting, inverted cylinder, triple expansion type, with cylinders 27½, 45½ and 73 inches diameter respectively, and 48 inches stroke. The high- and intermediate-pressure cylinders are fitted with working liners. The high-pressure cylinder is fitted with an 11-inch piston valve, the intermediate-pressure with a 22½-inch piston valve and the low-pressure with a double ported slide valve. The valves are operated by Stephenson link valve gear, controlled by a steam cylinder, 15 inches in diameter, and 26 inches stroke.

All piston rods are steel, 7⅛ inches diameter, and secured to pistons and crossheads by taper and nut. The crossheads are forged steel, with double pins 7¾ inches diameter by 8¾ inches long, with double cast iron slippers lined with white metal. The connecting rods are 114 inches between centers, with upper end forked, and tapered from 7 to 8 inches diameter. Brass boxes are fitted for crank pins and crosshead pins, the crank pin boxes being lined with white metal.

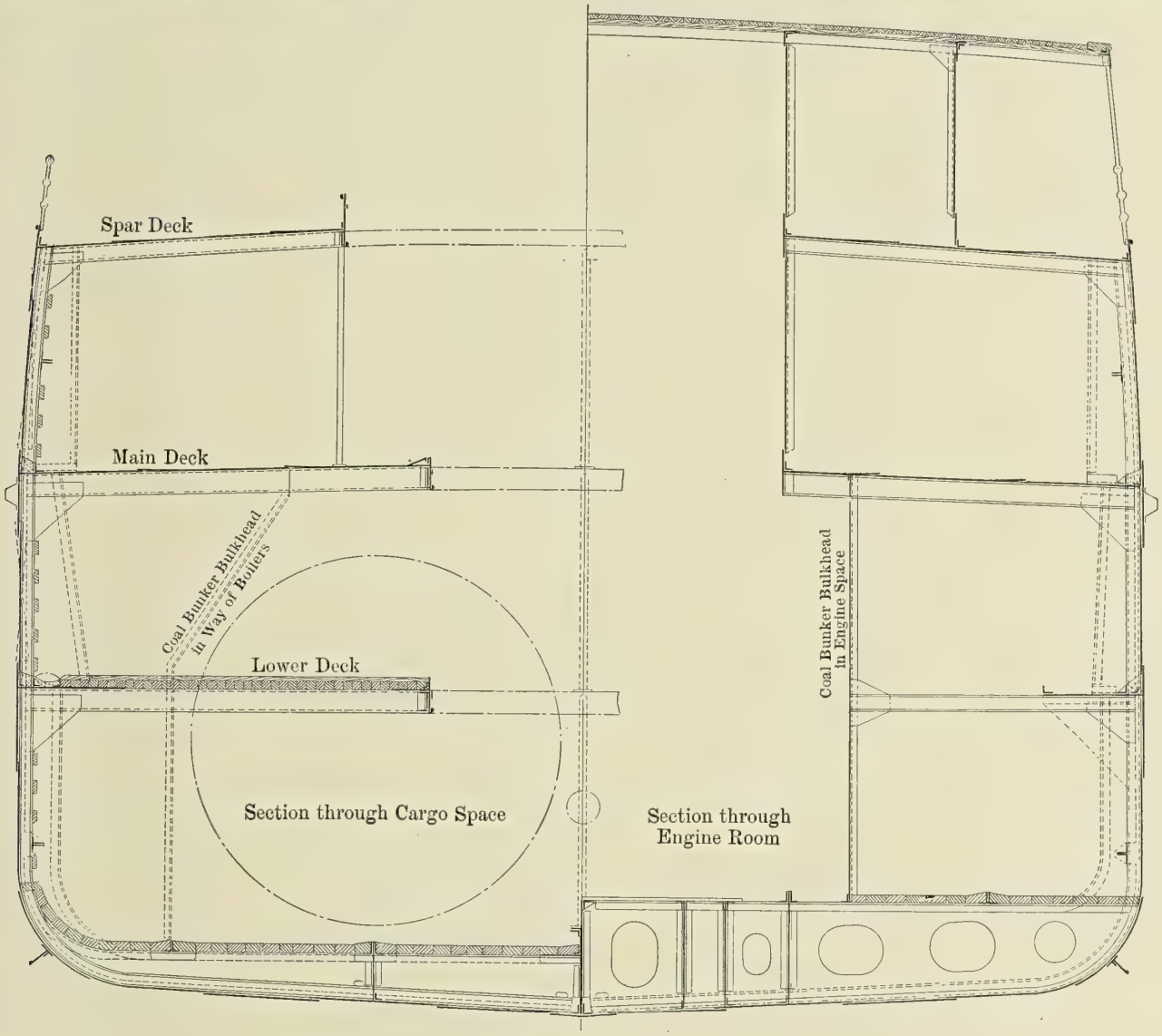
The cylinders are supported by cast iron housings of box section, with slides bolted to each. The front housings rest directly on the bed plate, but the back housings rest on top of the condenser, which forms part of the engine framing. The



THE PROPELLING ENGINE OF THE TUSCAN, SHOWING SIDE ELEVATION AND TWO END VIEWS.

bed plate is of a deep box section, cast iron, in three pieces, and has six main bearings, five being 15 inches long, and the after one 18 inches long. Each bearing is fitted with a cast iron box and a cast steel cap, both lined with white metal.

The crank shaft is forged steel, 15 inches diameter, of the built-up type, in two sections, the cranks set at 120 degrees and with the usual sequence. The crank pins are 15 inches diameter by 16 inches long. The thrust shaft is 15 inches diameter, with separate collars for ahead and astern, ten for ahead, and four for astern, all being 23½ inches diameter. The thrust shoes are cast iron lined with white metal, and the whole thrust block is provided with water circulation.



TRANSVERSE SECTIONS OF THE TUSCAN, SHOWING THE ARRANGEMENT OF DECKS.

All the line shafts are 14½ inches diameter, supported by cast iron steady bearings, lined with white metal and located about 16 feet apart. The tail shaft is 15 inches diameter, and fitted in the stern tube bearing by brass sleeves. Between these sleeves in the stern tube the shaft is covered by a copper sleeve. The stern tube is cast iron, fitted with brass stuffing box, and brass liner fitted with lignum-vitae staves. A sectional four-bladed propeller, with cast iron hub and manganese bronze blades, is fitted. It is 15 feet in diameter and has an adjustable pitch.

The condenser, as stated, forms part of the back framing, and contains 1,396 ¾-inch brass tubes. The cooling water is supplied by a centrifugal pump, having a 14-inch suction and discharge, and is driven by a vertical, independent steam engine 10 inches in diameter by 9 inches stroke. An auxiliary condenser of Wheeler make, with 600 square feet of cooling surface, has been provided for use of auxiliary machinery when in port; the 7½ by 10 by 10 by 10-inch air and circulating pump is located directly under the condenser.

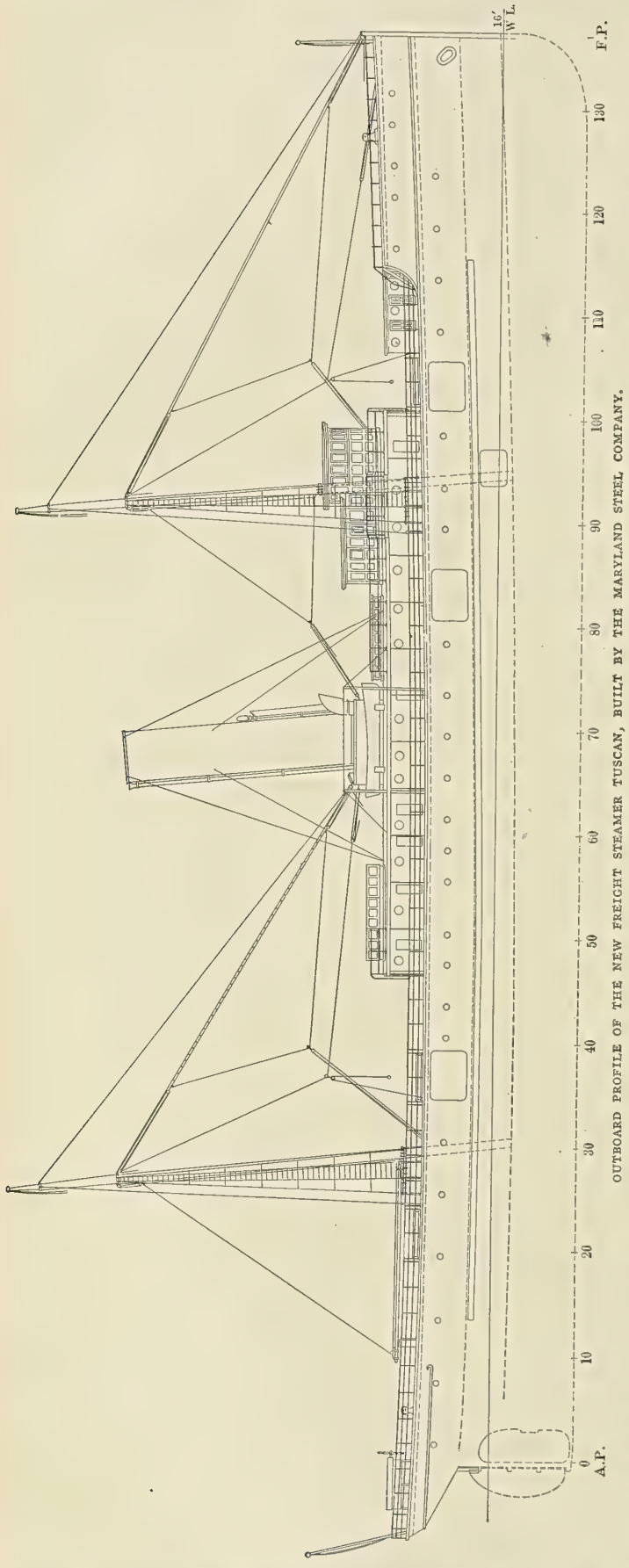
A steam turning engine with double cylinders 6 inches diameter by 6 inches stroke is provided. It is located on top of the main condenser, between low- and intermediate-pressure cylinders, and operates through a worm and shaft, and a worm wheel on crank shaft coupling.

All pumps are independent and of the Warren make, and comprise a 12 by 7 by 12-inch vertical duplex main feed, a 12 by 7 by 12-inch vertical duplex fire pump, a 7½ by 6 by 10-inch horizontal duplex bilge pump, a 7½ by 5 by 6-inch horizontal duplex sanitary pump, and a 7½ by 5 by 10-inch horizontal duplex forward deck pump. A Reilly feed water heater, with by-pass, is fitted in main feed line.

BOILERS.

The steam generating plant consists of four single ended Scotch boilers, each 13 feet 10 inches inside diameter, and 11 feet 11 inches mean length, with a working pressure of 180 pounds. There are three 45-inch Morrison furnaces, each having its own combustion chamber, and 265 3-inch tubes, in each boiler. The total grate surface is 281.2 square feet, and the total heating surface is 11,300 square feet; the ratio being 40.2 to 1.

A Bloomsburg circulator is fitted in the feed line in each



OUTBOARD PROFILE OF THE NEW FREIGHT STEAMER TUSCAN, BUILT BY THE MARYLAND STEEL COMPANY.

boiler. All boilers are connected to one elliptical stack, rising about 80 feet above the grate. Each furnace is fitted with the usual front plates, door plates, cast iron door and front liners, dead plates, etc., and also a complete set of Willoughby patent improved shaking grates.

For ventilating the fire room there are provided two 36-inch ventilators, and to assist the natural draft is a 54-inch Sturtevant fan driven by a vertical single acting 5 by 5-inch engine. This fan draws air from the fidley top, and discharges through regular ventilating ducts to both sides of the engine room and fire room.

Electric lights are fitted throughout the ship, and there is also an 18-inch Rushmore searchlight. The power is supplied by a 15-kilowatt General Electric marine generator.

The Olympia Motor Boat Show.

A large number of exhibitors of motor boats and appliances placed their wares in evidence in London from March 7 to 16. Among the notable exhibits might be mentioned the motor launch *Veradaise II,* by John I. Thornycroft & Company, Ltd., Chiswick, and a number of motors and reversing gears of a variety of types, built by the same firm. The Parsons Motor Company, Ltd., Southampton, exhibited engines of nearly all the sizes which they build, together with reversing gears and propellers, and a number of special fittings. J. W. Brooke & Company, Ltd., Lowestoft, exhibited three boats and half a dozen motors, with reversing gears and other items of outfit. The Seamless Steel Boat Company, Ltd., Wakefield, exhibited two steel launches, one having a length of 40 feet, and the other 15 feet, and each being complete, with propulsive power and outfit. De Dion Bouton, Ltd., exhibited an interesting motor boat, *Dion Bouton,* built of cedar, which has achieved remarkable results with regard to both speed and reliability. They also showed motors, reversing gears and propellers and carbureters. Dixon Bros. & Hutchinson, Ltd., of Southampton, exhibited two boats fitted with engines, and four engines ranging from 6 to 21 horsepower.

The New York Motor Boat Show.

The show under the auspices of the National Association of Engine and Boat Manufacturers, held this year in Madison Square Garden, New York, from February 19 to 26 inclusive, was the most successful from many points of view of all the shows which have been held. The sales were unusually large, indicating a great financial success for the exhibitors, and illustrating in very concrete form the hold which the motor boat has upon the public.

The exhibits were arranged mostly on the main floor of the Garden, the large tank, which formed so conspicuous a feature of the 1905 and 1906 exhibitions, having been absent. In addition to the space gained by dispensing with the tank, much more space was obtained by divorcing the Motor Boat Show from the Sportmen's Show, making each a separate entity.

Without going into detail about the exhibits, it may be said that the boats and engines shown, as well as the various appliances for the operation of the different features in connection with the boats, were of extreme interest; partly by reason of the great variety shown, and partly because of the excellence of the individual items comprising the total. Every method of construction of hull and engines was given ample space, and boats of every character filled the various stands. It may be said in general that the easy-going type of boat predominated, although there were a number of flyers represented in the exhibits. Most of the engines were of the power required for the cruiser rather than the racer, but some of them would easily fill a space in the latter class.

A Large Pacific Coast Dry-Dock. It is reported that the United States navy department is about to build a stone and concrete basin dry-dock at Hunter's point in San Francisco harbor, at a cost of $1,250,000 (£256,000). This dock, it is reported, will be the largest of its type, having a total length of 1,050 feet, and a depth over the sill of 30 feet 6 inches. It will be large enough to dock two battleships at once.

Increase in British Tonnage.

The increase in the tonnage of shipping belonging to the United Kingdom during the year 1906 is the largest on record, having exceeded that of 1902 by more than 40,000 tons, The additions to the register of the United Kingdom during the year include 860 steam vessels, aggregating 1,493,120 tons, and 232 sailing vessels, amounting to 23,404 tons. This makes an aggregate of 1,092 vessels covering 1,516,524 tons. The removals, including vessels lost, broken up and sold, cover 477 steam vessels, amounting to 588,613 tons, and 434 sailing vessels, aggregating 144,355 tons. Under neither the steam nor the sail removals is the figure a record. The total deductions amount to 911 vessels of 732,968 tons. The net additions to steam tonnage amount to 383 vessels of 904,507 tons. Sailing tonnage shows a decrease covered by 202 vessels of 120,951 tons. This makes a net addition of 181 vessels and 783,556 tons.

The average size of steam vessel added to the register is 1,736 tons. The average size of sailing vessel added to the register is 101 tons. The average size of steam vessel removed from the register is 1,235 tons. The average size of sailing vessel removed from the register is 332 tons.

The vessels of the United Kingdom on December 31, 1906, were as follows:

	Number.	Tons.	Average.
Steam	10,905	15,788,101	1,448
Sail	9,857	1,675,875	170
Total	20,762	17,463,976	841

This compares with figures for December 31, 1905, as follows:

	Number.	Tons.	Average.
Steam	10,522	14,883,594	1,415
Sail	10,059	1,796,826	179
Total	20,581	16,680,420	811

Of the total number of vessels added, 700 are of steel propelled by steam, and aggregrate 1,477,292 tons, or an average of 2,100. Nearly all of the sailing vessels are wood or composite, eight being of iron and fifty-eight of steel. Of the steam vessels, twenty-five are of iron and one hundred and thirty-five wood and composite. All of the latter classes are small, and of comparatively little value in the make-up of the fleet.

The Question of Ship Subsidies in the United States.

It is a matter of record that the second session of the fifty-ninth congress terminated in a frenzy of excitement on the subject of ship subsidies. Nothing was done by this congress on the subject, in spite of the great amount of talk and attention which had been brought forth. In this connection it may be pertinent to quote Daniel O'Connor, K. C. S. G., formerly postmaster general of New South Wales, and for many years prominent in political life in what is now the Australian Commonwealth. Mr. O'Connor is an ardent advocate of the subsidizing of a line of steamships between the United States and Australia. He said in part:

"The other great maritime countries of the world, like Germany, France, Italy, Great Britain and Japan, subsidize steamers for the Australian trade, and they do it because they think it pays to do so. Thousands every year leave Australia for trips to Europe and America, and ninety percent of them are traveling for pleasure, and have money to spend in sightseeing.

"If the United States subsidized a line of steamships, as it is proposed, the trip from Sydney or other Australian ports could be cut down to seventeen days, for 8,000-ton steamers of high power would be used in that trade. Such an arrangement would greatly increase the trade between Australia and the United States, and thousands of Australians would go to Europe by the way of the United States, stopping on the way to visit the principal cities of the American continent.

"The granting of such a subsidy would not be in any sense a gift, for I venture to say that it would soon multiply trade by ten or even twenty fold."

The Oceanic Steamship Company has notified the United States government that when the steamships *Ventura* and *Sierra* reach San Francisco on their present trips they will be withdrawn from the service between the United States and Australia. The two other vessels of this Line, *Mariposa* and *Alameda*, will continue the service for the present. The action regarding the first two ships was the result of the failure of congress to pass a bill to benefit shipping, and was also based in part upon the fact that the New Zealand government in its last budget did not include the usual appropriation for a mail subsidy. This withdrawal of support has rendered the operation of the steamers unprofitable.

Steamships Entering Valparaiso Harbor.

A recent report from the United States consul at Valparaiso gives a list by nationality and tonnage of the steamships entering the port during the years 1904 and 1905. In the former year the total was 360, aggregating 871,073 tons; in 1905, these figures had been increased to 370, aggregating 916,670 tons. The increase in numbers was 3 percent, and in tonnage, a little over 5 percent. Under both headings British steamers have a large lead, accounting for 204 vessels of 499,162 tons in 1904, and 211 vessels of 528,227 tons in 1905. German tonnage is about half the British, being 87 vessels of 248,012 tons in 1904 and 90 vessels of 265,462 tons in 1905. Chilian tonnage fell off during the year from 58 vessels of 93,171 tons to 55 of 85,606 tons.

The rest of the tonnage was divided up among French, Italian, Danish, Argentine, Dutch, Norwegian and American. The latter in 1904 covered one vessel of 743 tons. In 1905, no steamship flying the stars and stripes entered the most important harbor on the west coast of South America.

Canadian Steamship Subsidies and Subventions.

At the recent session of the Dominion Parliament the votes for 1906-07 covering marine items included a total of $1,020,188 for mail subsidies and steamship subventions. This amount was distributed over a large number of services, including the Canadian-Great Britain mail service, $275,000; seven other services to Great Britain, $108,000; services to Australia, New Zealand and South Africa, $299,357; services to Mexico, the West Indies and South America and on the Pacific coast, $155,350; local services between Canadian ports, $182,481.

Other items included in the vote and comprised in the general heading of marine matters included lighthouse and buoy services, $2,159,250; ocean and river services, including ice breakers and life-saving stations, $885,450; hydrographic survey, $220,000, of which $100,000 was appropriated for the construction* of a steamer to operate on the Pacific coast; quarantine service, $60,000; pilotage, $21,500. The total of these items, including the mail subsidies and steamship subventions, is $4,366,388.

In addition to the above the bill carried a total of $3,693,106 for canal purposes, making a total marine vote of $8,059,494. The canal items included $1,063,200 for the River St. Lawrence ship channel, and $1,014,873 for the Welland canal, between Lakes Erie and Ontario.

*See page 135.

Personals.

W. D. Forbes, Hoboken, N. J., has been designated by Admiral Bowles, President of the Society, as official representative of the American Society of Naval Architects and Marine Engineers, at the Marine Exhibition to be held in Bordeaux, France.

The offices of O. H. Taylor, passenger traffic manager, and C. C. Brown, general passenger agent, of the Consolidated Steamship Lines, have been removed from pier 32, North river, New York, to 290 Broadway.

Loss of the Steamship Dakota.

One of the two largest steamships ever built in the United States has run aground in the vicinity of the Mojima lighthouse, forty miles from Yokohama, Japan, and, at present writing, lies with her bow under water as far as the second mast, and her screws exposed. It is stated that she was carried on the rocks by a treacherous current peculiar to the locality in which she was stranded, and that her hull filled so rapidly that little hope is entertained for her recovery. The passengers and crew were safely removed, but all of the baggage and cargo is reported lost, with the exception of several bags of mail.

The *Dakota,* which is a sister of the *Minnesota,* was completed in the spring of 1905 by the Eastern Shipbuilding Company, New London, Conn., for the Great Northern Railroad. She was illustrated and described at page 248 of our issue for June, 1905, and page 290, July, 1905, the latter part of the description covering the machinery. (See also page 221, May, 1903, for the *Minnesota.)* She is one of only about a dozen ships afloat of over 20,000 tons, and, as such, is without question by far the largest ship ever wrecked. Her length over all is 630 feet, the extreme beam being 72 feet 6 inches, the depth of hull 56 feet at the side amidship, while the total depth from upper navigating bridge to bottom of keel is 88 feet 4 inches. The load displacement at her draft of 34 feet is about 33,000 tons, while the gross tonnage is 20,714. This is exceeded by the 20,900 of the White Star Line steamers *Cedric* and *Celtic;* 23,500 of the *Baltic* and *Adriatic;* 22,250 of the *Amerika* and 25,000 of the *Kaiserin Auguste Victoria* of the Hamburg American Line; and 32,500 of the *Lusitania* and 33,200 of the *Mauretania* of the Cunard Line. It is thus seen that only eight ships afloat exceed in size the *Dakota.*

A singular fatality seems to be pursuing the largest ships in service in the Pacific ocean. These are the two Great Northern ships just mentioned, and the *Manchuria* and *Mongolia* of the Pacific Mail Line, each of 13,638 tons. Both of the Pacific Mail steamers ran aground last year, and were with considerable difficulty hauled off. The *Minnesota* is now the only one of these four large ships which has succeeded in completely avoiding disaster of this sort. The *Dakota* was built at a cost of about $3,000,000 (£616,000), and is reported to be insured for $2,500,000 (£513,000).

A New Shipping Corporation.

The Consolidated Steamship Lines Company, with an authorized capitalization of $60,000,000, has been organized in Maine to conduct a general steamship business on the Atlantic coast of the United States. This company is a holding company, controlling the lines owned by C. W. Morse and including the Mallory Line, the Clyde Line, the Eastern Steamship Company, the Metropolitan and Ward Lines and the Troy and Peoples Lines on the Hudson River. These lines cover the entire Atlantic seaboard from Galveston, Texas, to St. John, New Brunswick, and carry both passengers and freight to and from a large number of ports along this great stretch of territory.

The principal coasting companies not in this combination are the Ocean Steamship Company, operating between Savannah and New York and Boston; the Old Dominion Line, running between New York and Norfolk; the Merchants & Miners Transportation Company, operating between Norfolk, Baltimore, Savannah and Boston; the Boston and Philadelphia Steamship Company; and the Morgan Line, running from New York to New Orleans and from New Orleans to Havana.

It is stated to be the purpose of this corporation, which has recently acquired possession of the New York & Cuba Mail Steamship Company, commonly known as the Ward Line, to establish a line of fast turbine steamships between New York and Havana. The fastest ships of the present company make the trip in three days, while slower ships occupy five days. The new vessels will, it is reported, cover the distance in two days, which signifies a speed of 22 knots. It is said that the ships will have accommodations for one thousand passengers each, and that they will be put into operation as soon as it is possible to build them.

Warship Construction in 1906.

Twelve powers launched warships in 1906, the number ranging from one, in the case of Holland and Spain, to nineteen in the case of Japan, eighteen for Germany and sixteen for Russia. The totals for the several powers are in the appended table, torpedo-boats and submarines not being included. The table shows number of vessels, aggregate displacement in tons, and average speed in knots.

	Armored.			Unarmored.			Destroyers.		
Great Britain	5	80,100	20.5	.....			5	1,150	26.
United States	3	45,000	20.6	.....			.....		
Germany ...	4	49,600	19.9	2	6,900	23.	12	5,760	28.
France	2	28,509	20.4	.....			4	1,344	28.
Japan	2	32,810	18.8	4	10,900	23.	13	5,018	29.
Russia	6	73,330	18.6	.....			10	3,960	26.
Italy	.....			.....			4	1,500	29.
Austria	.....			.....			3	1,200	28.
Holland	1	5,000	16.0	.....			.....		
Spain	.....			1	5,350	21.	.....		
Greece	.....			.....			2	780	30.
Peru	.....			2	6,400	24.	.....		
Total ...	23	314,349	19.7	9	29,550	23.	53	20,712	28.
Average size.		13,667			3,283			391	

The grand total is seen to consist of 85 vessels, aggregating 364,611 tons, or an average of 4,280. This compares with 363,211 tons in 118 vessels in 1905; and with 435,006 tons in 102 vessels in 1904.

The construction in 1906 is noteworthy in several particulars. In the first place only three of the armored vessels are of under 11,000 tons displacement, these being the Dutch coast defender and two Russian armored cruisers of 7,900 tons each. If we omit these three it is seen that the armored construction includes 20 vessels of an average of 14,677 tons each. Twelve of these vessels exceed 14,000 tons in displacement, and have the high average of 15,888 tons. The armored vessels include 12 battleships, aggregating 183,505 tons, or an average of 15,292, and 10 armored cruisers amounting to 125,844 tons, or an average of 12,584.

Of the unarmored vessels listed, the Spaniard is the only one under 23 knots, that ship having a speed of 21 knots. The two Peruvian cruisers are rated at 24 knots. None of the destroyers exceeds 30 knots and none is under 26, the average being 28.

New Steamship Lines.

Steamship service between British Columbia and ports on the west coast of Mexico is to be commenced in March, 1907. The service will be monthly, and it is stated that the operating company will receive from each government an annual subsidy of $50,000 in gold.

Service between New Zealand and British Columbia is under consideration, the proposal calling for the sailing of a vessel of 6,000 tons or above every three weeks. The vessels are to be furnished with refrigerating chambers for carrying fruit and dairy products, and must not exceed eighteen days on the trip in one direction. It is proposed to pay for this service a maximum subsidy of $100,000 in gold per annum.

The present direct connection between British Columbia and New Zealand is by two freight steamships making bimonthly trips, and paid a subsidy of $50,000 by each government.

The Ocean Steamship Company has started a service between Singapore and Manila. The first steamer to make the run was the *Teucer,* which is said to be the largest freighter ever passing through the Suez canal. This vessel was due in Manila November 20, 1906. She is new, having been built especially for the carrying of large cargoes. Her net tonnage is 9,017, and it is

stated that she can carry 20,000 tons of cargo. This service is a branch of a line running between Glasgow, Liverpool and the Orient, it being formerly necessary to tranship cargo for Manila at either Singapore or Hong Kong. The new service will obviate this necessity.

The American Shipbuilding Company reports that it has contracts for the construction of 50 vessels representing an aggregate expenditure of $18,000,000. Nearly all of these vessels are of large size, the average carrying capacity being increased from 8,700 tons last year to 9,200 tons at the present time. The present valuation of orders is $5,000,000 in excess of that in February, 1906. Thirty-six ships are to be turned out before July 1, an average of more than one a week.

TWENTY-FOUR-HORSEPOWER CRUISING MOTOR BOAT ARLETTE II.

Two Unique French Motor Cruisers.

Among the French builders of motor cruisers, as well as high speed motor boats, is the Société Delahaye, of Paris. The *Henriette* is a Delahaye cruiser equipped with a 12-horsepower gasoline (petrol) engine of the two-cylinder type, operating at a normal speed of 1,100 revolutions per minute. The motor occupies a floor space 900 millimeters long by 600 millimeters (36 by 24 inches). This boat took the first prize for cruisers in the second series at the "Course Paris à la Mer," and second prize in the general class of cruisers.

The *Arlette II.* is equipped with a Delahaye four-cylinder vertical gasoline engine, which develops 24 horsepower when operating at its normal speed of 1,100 revolutions per minute. This engine is 1.2 meters long, by 600 millimeters (48 by 24 inches).

GASOLINE DRIVEN TWELVE-HORSEPOWER FISHING BOAT HENRIETTE.

Vessels built by this company during 1903 numbered 29, of an aggregate carrying capacity in net tons of 166,000, or an average of 5,710. In 1904, 36 vessels were constructed, of a total carrying capacity of 206,000 tons, or an average of 5,720. In 1905, 20 vessels were constructed, with an aggregate of 164,400 net tons carrying capacity, or an average of 8,220. In 1906, the construction amounted to 30 vessels of 261,500 tons, or an average of 8,717.

It is announced that Harland & Wolff, the Belfast shipbuilders, have decided to expend £250,000 ($1,250,000) in the establishment of ship and engine repairing works at Southampton.

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Warship Construction.

Figures in another column show that there have been launched in 1906 no less than twelve battleships and ten large armored cruisers, besides ten smaller vessels, more than fifty destroyers, and a large number of submarines and torpedo boats. This does not look as if international disarmament were expected to follow the conferences of the Arbitration Commission at The Hague. One noteworthy feature in connection with this subject is the fact that Great Britain proposes to lay down in 1907 three new battleships of the *Dreadnought* type, this number to be reduced to two if a certain amount of disarmament is recommended at the conference.

As things stand, however, an annual output of about 400,000 tons of warships may be expected among the several nations, for some time to come. Instead, however, of the heterogeneous collection of ships of all classes, such as were found in naval programs ten or fifteen years ago, we find now that construction is limited to four or five types, of which the battleship and the large armored cruiser are approaching closer and closer in relationship with every set of new designs. The protected cruiser has practically disappeared from shipbuilding programs, except in small sizes coupled with high speed, under which classification it approaches very closely to the type of scout cruisers officially inaugurated by the British government in eight vessels of that type recently put into commission, but in reality represented long before that by a number of vessels of approximately that same size and speed. Notable among these earlier ships may be mentioned the *Piemonte,* of the Italian navy, constructed in England in 1888, and having the then remarkable speed of about 22½ knots on a displacement of 2,500 tons.

Torpedo craft of various sizes and classifications finish the list of types now building. Destroyers and torpedo boats are merely large and small editions of the same thing, the larger ones having been to within a year or two limited in size to about 400 tons, while the smaller have averaged not far from 100 tons. Recently, however, torpedo destroyers of large size have been laid down, the most conspicuous unit of which is the *Swift,* of the British navy, which has a displacement of 1,800 tons, and a speed of no less than 36 knots, to be obtained by the development of 30,000 horsepower. This vessel is in reality too large for the ordinary work regularly devolving upon a boat of the torpedo type, and it is probable that her radius of action will prove to be such that her largest usefulness will be as a scout, rather than as a destroyer. With a large coal supply, her tremendous speed (greater than that of any vessel now afloat, and exceeded only by the late *Viper* and *Cobra* of the British navy) should enable her to obtain possession of information regarding an enemy's movements, much greater in scope than would be possible with a slower craft. Barring accidents, she should be able to retire from any enemy too strong to meet, and the application of wireless telegraphy should permit her to communicate with the squadron of which she might form a part at distances of a good many miles.

The last item under the heading of torpedo vessels is naturally the submarine. This type is being developed in large numbers and a great variety of designs, particularly in France. Its value for coast defense service is very great indeed, but for fleet action it is extremely problematical. Severe limitations exist, both with regard to speed and vision, not to mention the fact that it is practically impossible to provide such a vessel with a very considerable radius of action. In any fleet encounter, the rapidly changing positions of the combatants would probably make it out of the question to employ submarines as a part of the fighting unit. This is due, of course, to the fact that the men operating them would have great difficulty in differentiating between friends and enemies, and their usefulness would thus be largely nullified. For purposes of pure coast or harbor defense, however, especially when operating without ships of war of the usual types, they may be said to form a very useful adjunct to the marine defenses of a nation. Their moral effect in this connection will probably be found quite as potent as the material effect resulting from their operations. If any harbor were known to be protected by a number of these craft, an enemy's fleet would be exceedingly chary about loitering in the neighborhood. When a fleet is in active progress through the water, the submarine, having a speed inferior to that of the fleet, is about as useful as a stationary mine; but when the fleet is

at anchor, or maintaining simply steerageway back and forth across the mouth of a harbor, the mine becomes animated, and increases in value many fold.

The twelve battleships launched in 1906 are notable for their great individual power. All but the two Germans have main batteries composed of 12-inch guns; while seven have secondary batteries of 8-inch to 10-inch guns. The total main and secondary batteries include 200 guns of 6-inch calibre and upwards. None has a main broadside of less than 3,000 pounds collective weight, five exceed 5,000 pounds, and two of these are of over 6,600 pounds. The average is 4,600 pounds. The speeds are, in the main, 18 knots, but two exceed 20 knots, and two others, Russians, are of only 16 knots.

Shipwrecks.

We had occasion a few months ago to call attention to the large number of shipwrecks which had recently occurred. In that comment, which was published in October, we mentioned a number of battleships and cruisers which had gone aground, in addition to the two large ships, *Manchuria* and *Mongolia*, of the Pacific Mail Company.

An epidemic of this sort seems to have overtaken maritime interests within the past two or three months. The present list includes a number of coasting vessels, or ships on short trips, in connection with the loss of which very serious casualties have occurred. The most notable instances of this character are, of course, the *Larchmont*, which was wrecked in Block Island sound in January, and the *Berlin*, which followed it a few days later at the Hook of Holland. In each of these cases the loss of life was about 150 persons. Two or three days later a steamer carrying about this same number of passengers ran aground off the coast of Crete, but fortunately without loss of life. The latest disaster of importance is that which overtook the mammoth steamship *Dakota*, of the Great Northern Line, in the harbor of Yokohama.

The first of the four accidents here outlined was due in part to stress of weather, but probably in larger part to negligence. The next two were due wholly to stress of weather, while the loss of the immense trans-Pacific ship is said to have been due to a treacherous current, which threw her upon the rocks in fine weather.

We called attention editorially last month to the fact that some provision was needed, looking to the abolition of such disasters as overtook the *Larchmont*, by the requirement of a sufficient subdivision of the ship into watertight compartments to enable her to maintain flotation under such conditions as were actually met in this case. A short contribution in the present number takes up the subject along these same lines, and makes especial reference to the use of watertight doors, two or three successful systems for the construction of which are available. It goes without saying that if owners are willing to risk their vessels in navigation in crowded waters by failing to provide suitable subdivision of this character, something should be done by the authorities to prevent any excessive loss of life by virtue of their taking the risk. This would, of course, involve refusing them licenses to carry passengers, unless adequate requirements were met in connection with the construction and fitting up of the ships.

With regard to the loss of such a vessel as the *Dakota*, it is hard to know what to say. The ship was very largely subdivided, even aside from the double bottom, there having been no less than sixteen watertight bulkheads fitted. This should have been ample to neutralize any grounding in relatively calm weather, and it seems to be something of a mystery how a ship with the enormous resistant qualities and reserve buoyancy of the *Dakota* could have become a total loss under such conditions.

What makes the loss of this vessel much worse from the point of view of the American merchant marine, of which she was one of the two largest members, is the fact that her owners have announced their intention not to replace her, but to permit the void caused by her removal from the list to be filled by the Japanese, or by anyone else who may happen to be in a position to take up the work. This means that by the loss of one ship more than 20,000 tons gross register disappear from the list of American shipping engaged in foreign commerce, and that nothing is in sight to take its place.

As we write, news comes of a marine disaster of an entirely different character. The French battleship *Iéna*, preparing for active service in the harbor of Toulon, was practically destroyed by an explosion of her own magazines, much as was the Japanese *Mikasa*, more than a year ago. Over one hundred lives are reported lost, and scores of men were seriously injured, either by the explosion itself or by the fire which followed it. This is a sort of disaster which it is very difficult to guard against. Men accustomed to the handling of high explosives become careless, and treat with scant respect the destructive agencies intrusted to their care. Many such accidents have occurred, and many more are bound to occur. It is only when, as in the present instance, the magnitude of the casualty calls particular attention to it, that active measures are instituted, looking to a more careful attention to details.

The *Iéna* was a first-class battleship, with a displacement of about 12,000 tons and a speed of 18 knots. Her main battery consisted of four 12-inch, eight 6.4-inch and eight 3.9-inch guns.

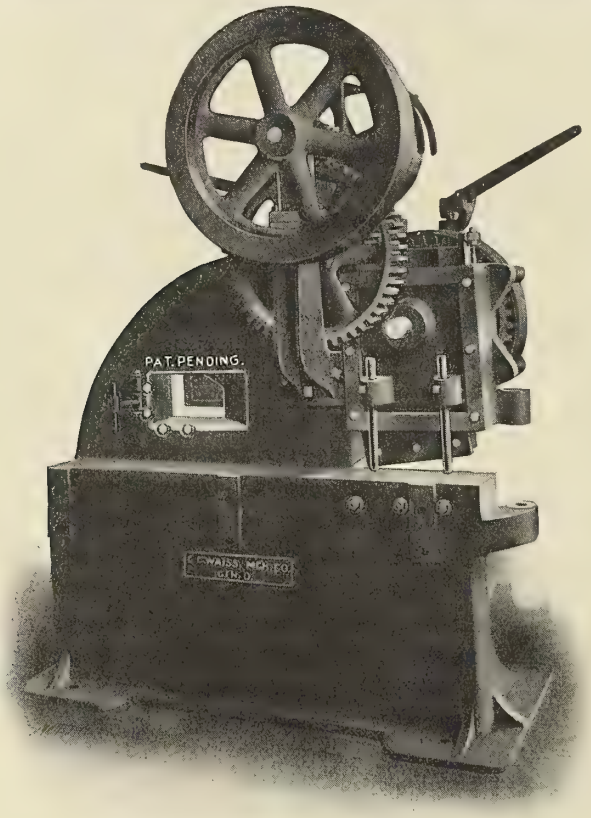
This calls to mind the fact that since January 1 there have been no less than nine serious accidents to French warships, in three of which loss of life occurred. In one case, that of the cruiser *Jean Bart*, the vessel became a total loss. Three of the accidents affected submarine boats; one, a destroyer; one, a torpedo boat; one, a cruiser; while the present is the second involving a modern battleship, the *Brennus* having gone ashore during a severe storm in February. The ninth case is that of the coast defender *Fulminant*, which was badly damaged by being struck by a torpedo.

ENGINEERING SPECIALTIES.

Universal Angle and Plate Shear.

The illustration represents a new universal plate splitting shear manufactured by the C. C. Wais Machine Company, Cincinnati, Ohio, for cutting plates, bars and angles of even and uneven legs, also small channels, by making extra shear-knives. The designer has found this shear a valuable tool for all boiler makers and metal workers.

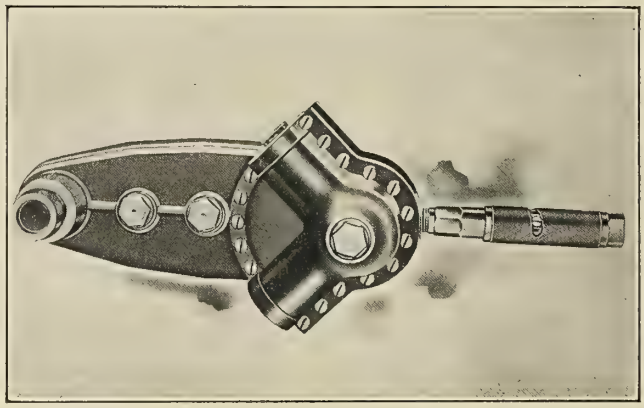
The square opening on the side is the angle shear, which cuts angles of even and uneven legs to any angle up to 45 degrees. Both shears are driven from one pulley, the angle shear running in a 45-degree angle, and can be operated singly or both at one time. The clutch stops only at highest point. The clutch lever is universal, and can be turned to any side, to suit the operator. Cutting uneven legs of angle iron has always been difficult to accomplish, and necessitated large, special machines for the work, which were too costly for small manufacturers. This universal combination shear embodies all the best features of the double angle iron shears, besides being a plate and bar shear which can readily be changed into a punch. It has proved a great labor saving tool. Bars can be cut on either shear, and an extra shear for small channels can be inserted on either side. The machine has been designed to save floor space, and is very strongly geared.



The Little Giant Corner Drill.

There is on the market a new "Little Giant" drill for corner work. It is said that this new drill surpasses any other drill yet devised for drilling in close quarters, and in corners particularly; the machine having been designed especially for work of the latter class.

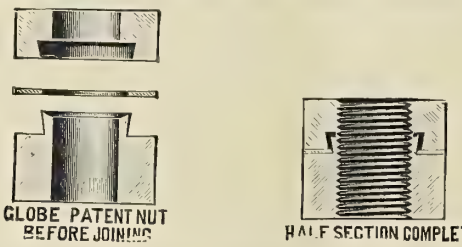
The new tool weighs but 35 pounds; has a capacity up to 1½ inches (but in emergency cases will drive 2-inch twist drills with very satisfactory results); spindle speed when running light 150 R. P. M.; under load with 80 pounds air pressure, 100 R. P. M.; distance from end of socket to end of feed screw when run down, 5⅞ inches; length of feed 2 inches; distance from center of spindle to outside of housing 1 5/16 inches. In addition to its being said to be the most powerful drill ever devised, weight considered, it possesses other advantages, owing to having the spindle driven by gears instead of by a ratchet, which insures steady and constant spindle movement.



The drill is made by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill.

A New Lock Nut.

The Globe Patent Lock Nut Co., of Bloomsbury street, Wolverhampton, is just putting on the market a new lock nut. The object of the invention is to provide a lock nut which, while of extremely simple construction, is of such a form that it can be readily secured in the required position upon any screw-threaded rod, and is not liable to work loose from vibration. The lock nut comprises two parts, one part provided with a circular recess having undercut sides, and the other part provided with an outwardly spreading projecting part, terminating in a circular lip, designed to be expanded within the recess, and a washer arranged between the two parts. The lock nut is formed in two parts, connected together so that one part is capable of turning over the other.



National Steel Tube Cleaner.

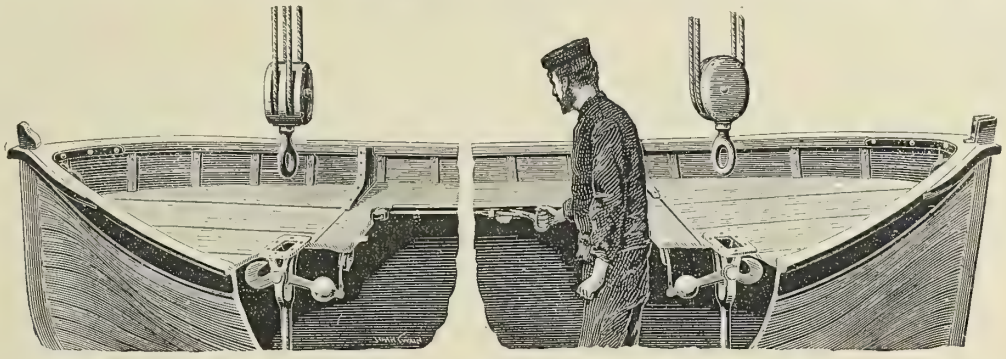
A salient feature of this cleaner is that each blade acts independently of the others, and is so spring-like in nature that it conforms very snugly to the surface which is to be cleaned. It can be forced through the tube with very little effort, and each plate removes the particles of sediment or scale within the pipe. Another advantage of this cleaner is that it can be adjusted to fit various sizes of pipe, and if one or more of its blades become broken by rough usage or wear, they can be readily repaired at nominal expense.

The cleaner is manufactured by the H. W. Johns-Manville Co., New York.

The Mills Disengaging Gear.

There has long been difficulty in connection with disengaging boats from davits at the proper moment. The gear manufactured by William Mills, Ltd., Atlas Works, Sunderland, is a very simple solution of the problem, the hook being held in position by means of the counterweight, shown in our illustration. A cord, run to each of the two blocks in the boat, is operated from a central position by one hand, and simultaneously throws the hook away from the ring in the block, as shown.

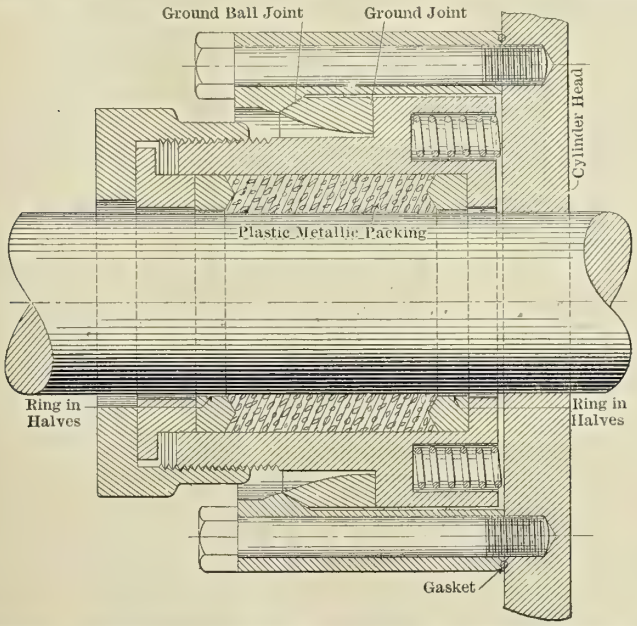
It is said that this device does not require a trained crew, is always ready for use, cannot get out of order, and that when



the gear is disengaged there is nothing to fall or to catch the gunwale. The hook is so formed that the block may be readily inserted without any danger of accident to fingers in rough seas. The boat cannot be disengaged until it is nearly waterborne, because of the weight acting upon the hooks. It is said to have been tested with perfect success when the ship was steaming as high as 16 knots. The American agent is A. P. Lundin, 17 Battery Place, New York.

A Vibrating Stuffing Box.

The illustration shows a specialty placed upon the market by the Steel Mill Packing Company, Detroit, Mich., which is said to automatically adjust itself to any movement of the piston rod or stem, out of the direct line. It will be seen that the box is arranged within a casing, being held against the ground ball joint ring by means of springs, assisted by the steam pressure from the cylinder. This keeps the joint tight and prevents

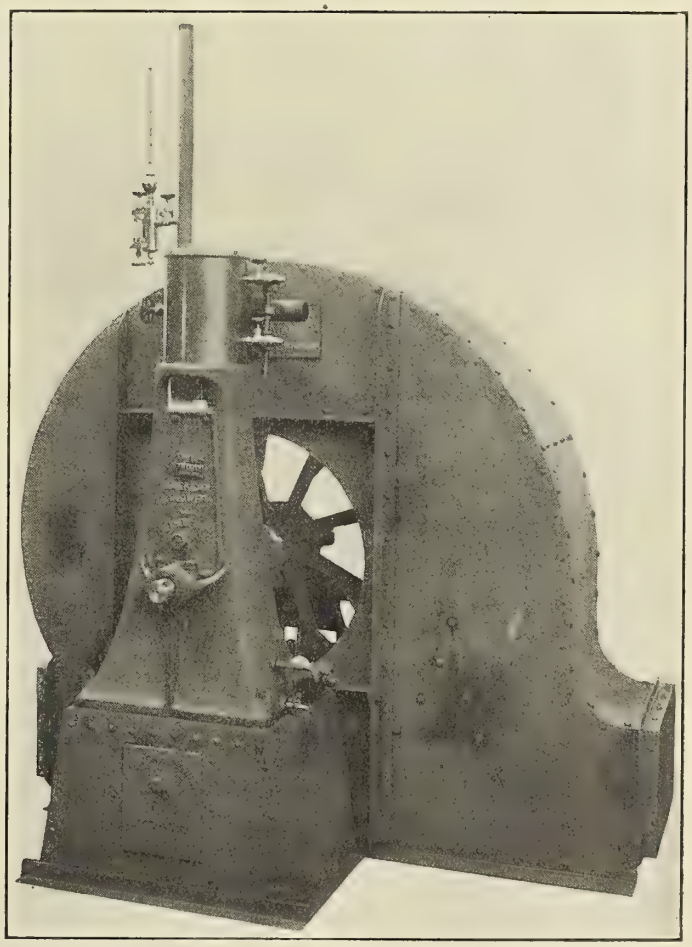


leakage. Clearance is provided between the stuffing box and the interior of the casing, and between the rear surface of the box and the cylinder head. This permits the box to move laterally relative to the casing, to compensate for any movement of the rod or stem, and to rock on the curved base or ball joint to adapt itself to any angular movement of the rod. The spacing rings at each end of the packing work in connection with it, keeping the stuffing box out of contact with the moving parts, and thus preventing wear.

One of these boxes was recently placed on the piston rod of a 100 horsepower engine, and the rod purposely placed out of line, so as to give an angular movement as well as a lateral movement of more than 1/16 inch. It is said that the box performed perfectly under these conditions, "floating with the rod."

A New Blowing Outfit.

A fan actuated by a single cylinder steam engine has been placed upon the steamer *Greyhound* by the American Blower Company, Detroit, Mich., with the primary object of forcing air into the boiler room to render conditions better for the fire-



men. In actual service it has been found that this results further in increasing the steaming efficiency of the boilers, with a resultant reduction in the amount of fuel consumed.

The 80-inch special fan is operated by a 5 by 5-inch engine, taking steam from a 1½-inch pipe and exhausting through a 2-inch pipe. The diameter of the wheel is 4 feet, the central inlet having a diameter of 33 inches. The width of the wheel at center is 19½ inches, and at periphery, 12¼ inches. The weight of steel in the blades is No. 14 B. W. G., while No. 18 is used in the rim. The discharge of the fan measures 13½ by 21 inches inside. The height of fan casing above the base is 5 feet 9 inches, while the length of the apparatus over all measures 6 feet 10 inches. The extreme width, covering both blower and engine, amounts to 4 feet.

TECHNICAL PUBLICATIONS.

The Thermo-Dynamic Principles of Engine Design. By L. M. Hobbs, Engineer Lieutenant, R. N. Size, 5¼ by 7½ inches. Pages, 143; figures, 57. London, 1907. Charles Griffin & Company, Ltd. Price, 4/6 net.

This book was written with the object of placing before engineers and students in a concise manner the thermo-dynamic principles underlying the designs of various forms of heat engines. Little has been incorporated in the work in the way of descriptions of the mechanisms of the various types of engine, except where it has been necessary in order to explain the theoretical principles involved. Everything has been treated from the point of view of the relations of pressures and volumes, the temperature-entropy diagram having been purposely avoided.

Free use has been made of the calculus in developing the theory, particularly in connection with the flow of gases in long pipes. The several chapters cover among other things engines operated by hot air, gas and oil, reciprocating engines, steam indicators and ejectors and steam turbines. An appendix gives questions for review, separated according to chapters, and with answers to each question. This makes the work thoroughly valuable for use as a text book. After the appendix come steam tables and an index.

The Steam Engine and Other Heat Motors. By W. H. P. Creighton, U. S. N., Professor of Mechanical Engineering, Tulane University. Size, 5¾ by 9 inches. Pages, 499; figures, 198. New York, 1907. John Wiley & Sons. Price $5. (London, Chapman & Hall, Ltd. Price 21/- net.)

This work reviews the elementary principles underlying the operation of a steam engine plant, and takes up in considerable detail the subjects of measurement of heat, entropy and the work of expansion as represented by curves. The design of the engine and the history of the application of steam to the production of power have been largely put into the background in favor of discussions upon the control of revolutions, tests of steam engines, the use of superheated steam and of gas engines, and producers. Refrigeration is given one chapter, while condensers, air pumps and small auxiliaries are accorded proper treatment. The cuts appear to be well chosen. Steam turbines are given some space in the chapter on superheated steam, it being recognized that the two subjects bear a close interrelation. Tables, an entropy diagram and a good index complete the work.

Steam Turbines. By Lester G. French, S. B. Size, 5¾ by 8¾ inches. Pages, 418; illustrations, 250. Brattleboro, Vt., 1907. The Technical Press. Price, $3 (12/-).

This work is divided up into twenty chapters, treating in successive steps of the principles upon which turbines operate, a review of the essential claims of important steam turbine patents, and a description of all the kinds of turbines in general use anywhere in the world. The performance of turbines is given considerable space, comparisons being instituted with the operation of piston engines, while calculations and diagrams are given, assisting in the design of the blading for use in turbines.

The mathematical treatment has been limited mainly to a discussion of the adiabatic flow of steam and to the principles of turbine vanes, these two items forming the basis of all turbine calculations. Illustrative examples have been incorporated in the text, and the mathematical side has been made as simple as possible. The last chapter covers the use of turbines in ships, and gives clear diagrams showing the arrangements of machinery in vessels fitted for turbine propulsion.

The illustrations are mainly linear, although a few half tones have been used. It may be said, however, that they are in general much superior to the cuts usually found in works of this character. They have apparently been made by the wax process, and are exceedingly clear.

The Marine Steam Engine. By Richard Sennett and Henry J. Oram, C. B. Size, 6 by 9 inches. Pages, 501; figures, about 500. London and New York. Longmans, Green & Company. Price, 21/- net ($6).

This is the eighth edition of a work which first appeared in 1882. After the death of Mr. Sennett, the succeeding editions were prepared by Mr. Oram, and, on account of great changes taking place in marine engineering, much of the material had practically to be rewritten. Among the new chapters in the last few editions may be mentioned those on watertube boilers, oil fuel arrangements, internal combustion engines and the marine steam turbine. In the present edition the chapter on the turbine has been largely amplified, and details of the construction of the turbine have been given a great deal of attention, a large number of drawings being used to illustrate the various points involved. The chapter on internal combustion engines is an entirely new one in this edition, it having been considered that the rapid introduction of this form of motor render it particularly advisable to give it space in a work of this character.

The care and management of marine engines and boilers have been dealt with in considerable detail, with the idea of making this portion of the work of much value to the operating engineer. An appendix treats of the application of the indicator diagram to determine stresses on the crank shaft, and curves of twisting moments. Here are also treated the effect of the inertia of the reciprocating parts of engines. A very complete index renders the work valuable for ready reference.

Steam Turbines: Their Development, Styles of Build, Construction and Use. By Wilhelm Gentsch. Translated from the German by Arthur Liddell. Size, 7 by 10¼ inches. Pages, 376; illustrations, 637, including 19 plates. London and New York. Longmans, Green & Company. Price 21/- net ($6 net).

The present contribution goes into the subject with characteristic German thoroughness in the matter of description and illustration, but avoids completely all reference to the general theoretical aspects of the situation. This being the case, mathematical treatment is entirely omitted, the work being confined to descriptive material in great profusion, and covering large numbers of different types of apparatus.

The portion of most interest to our readers is the last chapter, which covers seventeen pages, and is devoted to steam turbines for use on shipboard. In this chapter descriptions are given of Parsons outfits, together with some information regarding those of the Rateau and the Schultz turbines, with a list of vessels propelled by Parsons turbines, and with plates showing the arrangement of these turbines in passenger steamers, torpedo boats, and small cruisers. Quite a little information is given regarding the vessels in question, with regard to dimensions, trials, economy, etc.; and a large amount of data is included in the work as a whole, covering tests of turbines under widely varying conditions, and operating for various purposes.

The use of superheated steam receives rather scanty attention in the chapter devoted to it, but is taken up to some extent in other places in discussions of tests in which superheated steam is used. The utilization of the exhaust steam is given some attention. Governing appliances are given a chapter in which centrifugal and electrical governors are considered. Some attention is paid to reversing gear, and descriptions are given of certain attempts to reverse the direction of operation of a turbine designed to revolve in one direction.

The Theory of the Steam Turbine. By Alexander Jude. Size, 6¼ by 8¼ inches. Pages, 295; illustrations, 252 + three folding plates. London, 1906. Charles Griffin & Company, Ltd. Price, 15/- net. Philadelphia, J. B. Lippincott Company. Price, $5 net.

In this volume an attempt is made to present the fundamental principles of the operation of a steam turbine in a concise and connected manner, and in a way which will enable these principles to be applied directly to the turbine problem. The descriptive matter included has been curtailed to a minimum, but is in sufficient quantity to afford an idea of present developments and probable future progress in design and manufacture. Treatment is given of the subjects of leakage, governing, etc., and the results of some hitherto unpublished researches on the impact of steam into the buckets and flow through them, and the erosion of metallic surfaces due to the impact of high velocity steam. Several side issues have been brought into the book, in the shape of applied thermometry, and the subject of the specific heat of superheated steam, these being of particular importance in connection with steam turbine work.

The illustrations are almost entirely in the nature of line cuts, showing sections of various parts of the apparatus; diagrams showing the operation of steam, both in itself and in connection with nozzles and buckets; diagrams showing the relation between various features connected with the operation of the turbine, such as steam pressure, vacuum, consumption and power, and the expansion of steam. The efficiency of turbines is taken up in considerable detail, including the influence of the relative lengths and thicknesses of the vanes, and the effect of leakage. The text appears to be thoroughly well illustrated by the numerous cuts.

Unsinkable Ships. Size, 12 by 9½ inches. Pages, 80; illustrations, 41. London, 1906. Adams Brothers.

This is really a catalog of J. Stone & Company, Ltd., Deptford, London, S. E., describing the Stone-Lloyd hydraulically controlled watertight bulkhead doors. It has been put together so splendidly, however, and, with its illustrations of many of the most important and notable ships afloat, forms such a record, that it is deserving of more than the casual attention which would be given a catalog. Nearly all of the left hand pages show full page illustrations of ships which have been fitted with the system in question, while a number of folding plates illustrate by drawings the installations in particular ships, under this heading being included the *Lusitania, Deutschland,* and *Kaiser Wilhelm II.* Illustrations are also given of the different types of doors, operating by sliding either vertically or horizontally, and a special door which closes by a cleaving action, being pivoted at one corner. The illustrations are printed on heavy coated paper, and the book is very handsomely arranged.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

Q. 368.—A steamer 80 feet long, 16 feet wide and drawing 9 feet 10 inches aft and 6 feet 8 inches forward has a Scotch boiler measuring 6½ feet in diameter and 10 feet long, with a single 36-inch furnace, 8 feet long, and with one hundred and fifty-one 2½-inch tubes, 8 feet long. The pressure is 150 pounds per square inch. A vertical tandem surface condensing engine with cylinders 10⅛ and 20 inches in diameter with a 16-inch stroke drives a four-bladed propeller, 67 inches in diameter and 96 inches in pitch, at 140 revolutions per minute with 125 pounds steam pressure. The speed is 10 miles per hour with a cut-off in high-pressure cylinder at 73 percent stroke. The boiler readily maintains this speed on natural draft, and with the same cut-off and careful firing can be made to maintain 150 pounds steam pressure, which produces 146 revolutions per minute It has been suggested that the speed of vessel might be increased by reducing the high-pressure cylinder in diameter to about 8 inches, with proportionate increase in the piston speed, maintaining 150 pounds steam with the same cut-off. What will you advise? J. F. C. S.

A.—The engine, as now fitted, must give, according to the information above, about 85 indicated horsepower. The speed of 10 miles per hour means 880 feet per minute. A propeller with a pitch of 8 feet, and operating at 140 revolutions per minute, accounts for a theoretical propeller speed of 1,120 feet per minute. The difference of 240 feet per minute indicates a slip of about 21 percent. It is not likely that any small change in the pitch of the propeller would have much effect in reducing this slip.

If the diameter of the high-pressure cylinder were to be reduced to 8 inches by means of a properly proportioned cylinder, and the total steam used be the same as before, with the same ratio of cutoff, this would mean that the revolutions must be increased from 140 per minute to about 220. The total expansion of the steam from the initial point to the exhaust from the low-pressure cylinder would be greater than at present, and a moderate increase in the power developed might be expected. Just what this increase would be would depend largely upon the ability of the engine to maintain the speed of revolution above mentioned, which in turn would depend upon the design of the propeller. In any event, the increase in speed to be expected from such a change as this would be very slight, not perhaps more than one-half mile per hour, which would probably not be a sufficient gain to pay for making the change.

The propeller, if assumed to operate at the same slip as before, and giving a speed of 10.5 miles per hour, in place of 10, would have a pitch of about 64 inches in place of the present pitch of 96 inches. If the diameter were 67 inches, and the width of blades 17 inches, as at present, it seems reasonable to suppose that the results desired might be obtained. It is even possible that a slightly decreased width of blade might be used with the higher number of revolutions per minute. This is based on the fact that the velocity component of the power absorbed by the propeller has been somewhat increased, and that, although the actual power to be developed has increased by about 16 percent, the thrust factor has been only slightly increased. The narrow blade would produce less churning of the water.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

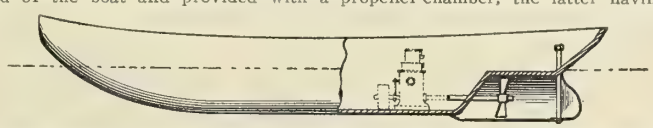
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

834,692. REEFING SAILS. MAX TORNOW, NEW YORK.

Abstract.—The sail may be wound up to any desired extent by the rotation of the boom, and therefore reef bands or knittles will not be required, and the area of sail may be reduced to any desired extent. Four claims.

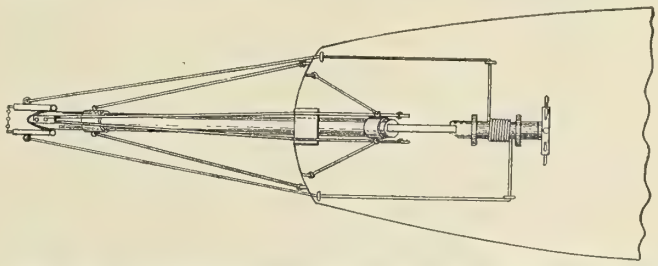
835,530. BOAT. JASPER N. HUFF, CONFLUENCE, KY.

Claim.—1. A boat having in its bottom a longitudinal plank or timber formed with an integral enlarged portion projecting beyond the rear end of the boat and provided with a propeller-chamber, the latter having



an open bottom and rear end, an upwardly and rearwardly inclined front end wall and parallel side walls having portions extended below the plane of the bottom of the boat and flared outwardly at their front ends to direct the water into said chamber. Two claims.

835,800. JURY-RUDDER. REINERT OLSEN, SAN FRANCISCO, CAL.

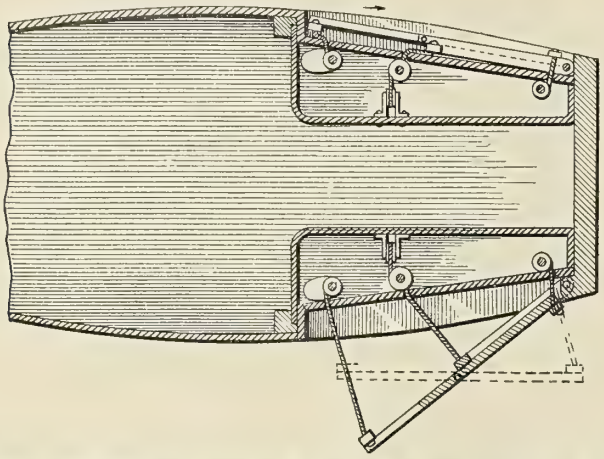


Claim.—3. A device for steering vessels consisting of a spar having eyebolts fixed near its outer and inner end, other eyebolts fixed to the vessel, ropes passing through the eyebolts of the spar and those upon

the vessel to fix the spar in position, rudders having pintles upon each side of the lower end of the spar, connections between the rear edges of the rudders whereby they are movable in unison, and tiller-ropes connecting with the outer sides of the rudders, guides upon the vessel through which the tiller-ropes pass and a steering mechanism with which they are connected. Four claims.

836,542. AUXILIARY RUDDER. WILLIAM M. TAYLOR, OF MECKLENBURG COUNTY, VA.

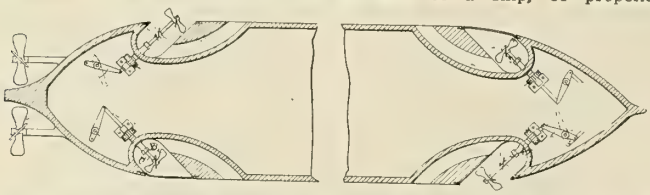
Claim.—2. The combination with the hull of the ship, of frames hinged at their rear ends to the stern thereof, fins pivoted by their centers on



a vertical axis within the frame, at the free end thereof, means for limiting the outward movement of the free ends of the frames with respect to the hull, and means for swinging the fins on their pivotal connection with the frame whereby to oppose said fins to the direction of motion of the water or to place them in parellelism therewith. Six claims.

837,288. STEERING DEVICE FOR SHIPS. JOHN DIECKMANN, MILWAUKEE, WIS., ASSIGNOR OF ONE-THIRD TO AUGUST BORTH, MILWAUKEE.

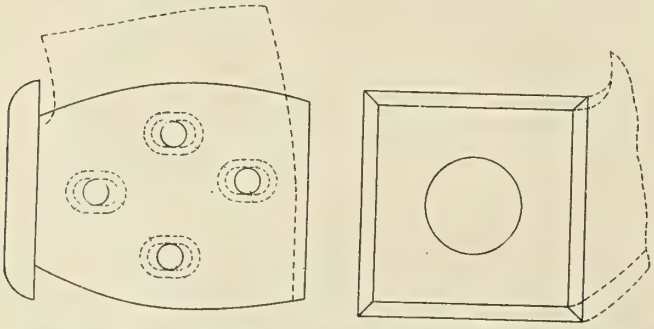
Claim.—3 The combination with the hull of a ship, of propeller-



wheels located between the respective ends of the ship, and normally disposed within recesses in the hull of the ship; and axially-movable shafts for driving the propeller-wheels; said shafts being arranged to project through the wall of the ship's hull. Three claims.

837,391. SCREW-PROPELLER FOR NAVIGABLE VESSELS. THOMAS EATON, NORTHWICH, ENGLAND.

Claim.—1. In a screw-propeller comprising separable blades and boss, the said boss, and the roots of the blades by which they are attached to



the boss, being curved in the fore-and-aft direction of the propeller, and the boss and blades adjustable longitudinally in relation to each other, whereby the pitch of a blade can be varied by longitudinal adjustment. Three claims.

837,551. METHOD OF SEA-SOUNDING. ALBERT F. EELLS, BOSTON, MASS.

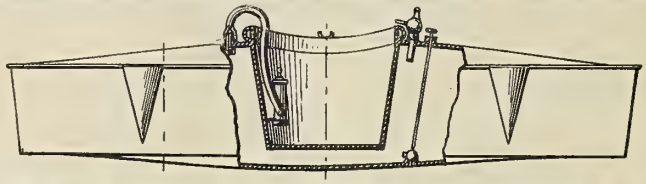
Abstract.—The present invention consists in determining the distance between a ship's keel and the bottom of the sea either by utilizing the echo from a sound made on shipboard or by the return of an impulse due to the disturbance of the water at or near the surface of said water. Two claims.

837,568. VESSEL-PROPELLING MECHANISM. MARTIN B. HUNTER, KANSAS CITY, MO.

Claim.—1. In vessel-propelling mechanism, the combination of a reciprocatory carriage, a shaft carried thereby, one or more propelling-paddles carried by the shaft, a latch mechanism for holding the shaft rigid with relation to the carriage, means for rotating the shaft a half-revolution to face the paddle or paddles in a new direction, and means for automatically disengaging the latch mechanism to release said shaft preliminary to its rotary adjustment. Ten claims.

839,321. BOAT. WILLIAM A. RICHARDSON, CORSICANA, TEXAS.

Claim.—8. A boat comprising a shell composed of a hull and a deck, a second shell extending through the deck and toward the bottom of the hull and constituting a cockpit for said boat, the two shells presenting an air-chamber within the boat, a valved air-vent in said deck, said hull having

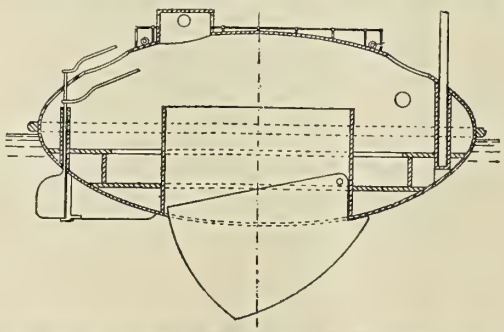


a hole for the entrance of water opening into said air-chamber, a valve for said hole provided with a stem extending through said deck and having a handle above the deck, and an air-pump within said second shell provided with a conduit extending therefrom and through the deck to provide for the expulsion of water from said air-chamber by the action of said pump. Eight claims.

British patents compiled by Edwards & Co., chartered patent agents and engineers, Chancery Lane Station Chambers, London, W. C.

17,371. LIFE-BOAT. O. BRUDE.

A sailing life-boat which affords shelter to the occupants and may be equipped for a long voyage. The hull is of ellipsoidal form, access to the interior being obtained through fore-and-aft manholes having watertight covers hinged to the deck. Near the bottom is a deck, and around the interior is a seat, the space beneath the seat and deck being utilized for storage. A socket receives the mast. A drop keel is provided, which may



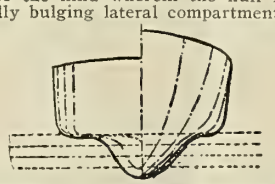
be drawn into the space shown by any convenient means. The rudder is provided with two tillers, the outer one being removable and for use in fair weather. A conning tower is provided for use when steering from the inside. Windows are provided at such a height above the seat that they may be used as oar ports. A fender is fixed around the hull, and the boat may be suspended from the davits by eye-bolts.

18,022. REVERSING GEARING. A. W. ROBERTSON.

Gearing suitable for propelling boats, of the type in which a direct drive is produced through a clutch, and a reverse is obtained through a countershaft and an idler friction pinion. The shaft carries a toothed wheel which meshes with a wheel on a countershaft, driving that shaft in the opposite direction. The shafts carry friction wheels, and reversal is effected by disengaging the clutch and causing an idler pinon to descend between and gear with the wheels. Turning a handwheel effects the double operation through a screw, a nut, and a lever. The lever is screw-threaded on a non-rotating sleeve attached to the movable part of the clutch, and is restrained between guides so that the lever, as it turns, traverses the sleeve longitudinally and operates the clutch. The lever has an extension connected by a link with a crank upon a rock-shaft, which carries an eccentric. As the lever turns, the eccentric is rotated and, through a link raises or lowers a frame, in which the pinion is journaled in such a way as to allow slight lateral play to its bearing blocks.

18,055. SHIP'S HULL. SAUNDERS PATENT LAUNCH BUILDING SYNDICATE AND S. E. SAUNDERS.

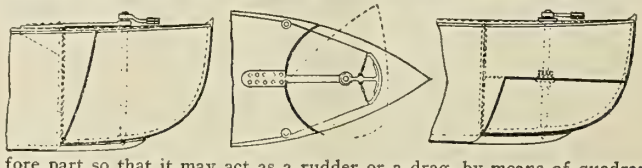
In a motor launch of the kind wherein the hull is formed of a central portion having outwardly bulging lateral compartments, and a median chan-



nel-shaped chamber serving as a keel, the hull is constructed with a flat bottom, and the median chamber is comparatively narrow, and tapers from amidships to the bow, and to a point about half-way to the stern. The vessel is made of wire-laced veneers.

20,517. BOATS' RUDDERS; STOPPING WAY. T. CROUCH.

Relates to improvements in that class of bow rudders formed of a movable part of the general structure of the ship or boat. A watertight compartment, conforming to the outline of the vessel, is mounted, approximately at the centre of its length, upon a vertical pivot. The pivot, which is carried in bearings in stays secured to the vessel, is operated, in order to turn



the fore part so that it may act as a rudder or a drag, by means of quadrant gear and chains, or by other steering gear. The surfaces are of such a nature that part of the heel of the rudder is always housed, even when it is placed in the athwartship position. Suitable gear is provided for locking the rudder at any desired inclination. A modified arrangement, in which the rudder is not the full depth of the vessel, is also shown.